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[OFFICIAL NOTICE.]

Twenty-fourth General Meeting, American Gas Light Association.

OFFICE OF THE SECRETARY,
PROVIDENCE, R. I., October 7, 1896.

There will be an adjourned annual meeting of the American Gas Light Association held in St. Louis, Mo., on October 27, 28 and 29, 1896.

The meeting will be called to order by the President, C. J. R. Humphreys, of Lawrence, Mass., at 9:30 o'clock, A.M., on Tuesday, October 27, in the meeting hall at the Planters' Hotel, the headquarters, which occupies half a block on Fourth street, between Pine and Chestnut.

The Planters' is one of the very finest hotels in the West, and is conveniently reached by the principal street car lines, and is amply large enough to take care of all who attend the convention. The most satisfactory quarters are always obtained by writing in advance to the hotel people, and in doing so a reply should be requested, for which a self-addressed stamped envelope should be enclosed, as misunderstandings may thereby be averted. The Planters' is conducted on both the American and European plans. On the American plan there will be a few rooms at $3.50, plenty of rooms at $4, with bath, $5; or two adjoining, with bath between, $4.50 each, and up. European plan, $2 and $2.50 and up. Rates are the same for corresponding rooms on all floors above the third. The Southern Hotel is a fine house at Broadway, Fourth and Walnut streets, 2½ blocks from the Planters', and is American plan, $3 to $5 a day. The Lindell is a good house on Washington avenue, between 6th and 7th streets, six blocks from the Planters', and is American plan, $2.50 to $4.50 a day.

The change of date from the third Wednesday of October was made positively necessary by an entirely unforseen occurrence. During the first week of that month St. Louis is filled with visitors to the fall festivities, and this year the second week was chosen for the meetings of two very large associations, the Carriage Makers and the Street Railway people; but as the hotels would be unable to take good care of two such large conventions at the same time, the Street Railway convention was changed to the week of the third Wednesday, and as that convention meant about 3,000 persons in attendance, our members could not have been comfortably housed. The President and Secretary therefore went to St. Louis, and after mature consideration in consultation with the local members, it was finally decided that to hold our meeting on Tuesday, Wednesday and Thursday, October 27, 28 and 29, was the best arrangement that could be made.

In order to have the meeting of the 27th strictly in accordance with the Constitution, the annual meeting will be held at St. Louis on the date provided by the Constitution, namely, the third Wednesday of October It is not expected to transact any business then, but with the assistance of the members already provided for, adjournment will be had to the date mentioned at the beginning of this circular, namely, Tuesday, October 27, at 9:30 A.M.

The meeting hall will be the Ladies' Ordinary, on the parlor floor of the Planters' Hotel; thus the headquarters and hall will be in the same building.

The roll call will be made by means of the door card system. Each member upon entering the hall for the first time will at the door receive a special card upon which he will find his name, address, etc., as it appears on the Secretary's books, and such card should be corrected and given to the doorkeeper. Members in attendance should attend to this very carefully, as these cards are used immediately after the meeting for correcting the annual membership list. Visitors will please hand to the doorkeeper their personal cards.

A blank form of application for membership accompanies this circular. More can be obtained of the Secretary.

Remember, all applications must be in the Secretary's hands by October 17, at the very latest, otherwise they will not be acted upon at this meeting.

The list of papers to be read at the meeting is as follows:

"A Discussion of the Methods Employed in Introducing Gas Stoves," by Charles H. Nettleton, Derby, Conn.

"Some Experiments on Internal Illumination," by Carter H. Page, Jr., Philadelphia, Pa.

"Inclined Retorts up to Date," by Frederick Egner, Norfolk, Va.

"A Modern Retort House," by Wm. A. Miller, Cincinnati, O.

"The Separation of Water Gas Tar," by Alten S. Miller, Long Island City, N. Y.

In addition to the above there will be several topics brought in for discussion by short written introductions. Three of the short topics already provided are:

1. "An Experience with Prepayment Meters."
2. "Wet or Dry Heat—which Gives Best Results in Purification?"
3. "The Use of the Jet Photometer."

All questions for the Question Box should be sent in to the Secretary as soon as possible in order that they may be printed in the next circular before the meeting, thereby insuring their discussion.

During the days of the meeting all announcements will be posted on the bulletin board in the meeting room. All members are warned to take notice thereof accordingly.

All members attending the meeting are particularly requested to wear their membership badges in plain sight, thereby greatly aiding the officers and the Local Committee in their work, by affording a ready means of recognition.

In order that the Year Book containing the report of the St. Louis

meeting may be published and issued to the members immediately after the meeting, notice is hereby given that if any of the speakers at that meeting desire to correct their remarks in discussions before they are printed, they will be given an opportunity before leaving St. Louis, but *not* after. The stenographer will have typewritten copy of the principal discussions prepared at the headquarters between the sessions of the meetings, and all those who desire to correct their remarks *must* notify the Secretary at the close of the session at which such remarks are made, as all the report will be turned in to the printer immediately after the adjournment of the meeting.

Special rates for transportation have been granted (viz., full fare going and one-third fare returning by the same route) by the several Passenger Associations named and under the conditions noted.

The Central Passenger Committee, covering the following grounds: Bounded on the east by Pittsburgh, Salamanca, Buffalo and Toronto; on the north by the line of and including points on the Grand Trunk Railway from Toronto to Port Huron, thence via Lakes Huron and Michigan to the north line of Cook county, Ills.; on the west by the west line of Cook county and the Illinois and Mississippi rivers, to Cairo, including Burlington, Keokuk, Quincy, Hannibal and St. Louis; and on the south by the Ohio river, including points on either side of that river.

The Southern States Passenger Association, covering the territory south and west of the Virginias and south and east of the Ohio and Mississippi rivers.

The Trunk Line Passenger Committee, covering territory west of New England and east of Niagara Falls, Buffalo and Salamanca, N. Y.; Pittsburgh, Pa.; Bellaire, O.; Wheeling, Parkersburg and Charleston, W. Va.

The New England Passenger Association, covering nearly all of the lines in the New England States.

The Western Passenger Association, from points in Eastern Committee and Trans-Missouri Committee Territories.

The following extracts from the regulations of the railroads are cited for the information of the members. The special rates are granted subject to these regulations:

1. The reduction is conditional on there being an attendance at the meeting of not less than 100 persons holding certificates.

2. Each person to obtain the excursion rate must purchase a first-class ticket (either limited or unlimited) to the place of meeting, for which he will pay regular fare, and upon request the ticket agent will issue a printed certificate of purchase of the standard form. Agents at all important stations are supplied with certificates.

3. If through tickets cannot be procured at the starting point, purchase short-trip ticket to the most convenient point where such through tickets can be obtained, and there purchase through to place of meeting, requesting a certificate from the ticket agent at the point where each purchase is made.

4. Tickets for the return journey will be sold by the ticket agent at the place of meeting at one-third the highest limited fare, only to those holding certificates signed by the ticket agent at point where through ticket to place of meeting was purchased, and countersigned by signature written in ink by the Secretary of the Association, certifying that the holder has been in regular attendance at the meeting.

5. No reduction of fare will be made on the return passage if the going ticket is purchased more than three days before the opening date of the meeting; except that when meetings are held at distant points to which the authorized limit is greater than three days, tickets may be purchased before the meeting in accordance with the limits shown in regular tariffs.

6. Certificates are not transferable, and return tickets secured upon certificates are not transferable. The transfer of any such is liable to prevent the securing of reduced rates for future meetings.

7. The certificate of agent at starting point, duly endorsed by Secretary of Association, must be presented to ticket agent at place of meeting, within three days (Sunday not reckoned except by Southern Passenger Association) after adjournment of meeting. The return ticket will be for the line or lines covered by the going ticket.

8. No refund of fare will be made on account of any person failing to obtain a certificate.

Special.—Those wishing to join the New York party should communicate with C. E. Sanderson, 32 Pine street, N. Y. City. Be sure to obtain your railroad certificate when buying your ticket for St. Louis. Apply for ticket and certificate at least 30 minutes before train time. Each person must sign his own certificate at time of purchasing ticket for St. Louis. Be sure to have the Secretary endorse your certificate at St. Louis as soon as you get there. Apply for return ticket at least 30 minutes before train time, and have your certificate with you. Any person, ladies included, attending the meeting, is entitled to the reduced rate from the territories named.

Members will please hand their certificates to the Secretary, or his Clerk, upon arrival at place of meeting. If there are one hundred members present, holding certificates, each certificate will then be properly endorsed and handed back to owner before adjournment.

Extracts from the Constitution.

Sec. 12. Application for active membership or for associate membership, or for transfer from associate to active membership, must be received by the Secretary at least 10 days prior to the meeting at which the application is acted on.

51. No member who owes two years' dues shall be entitled to vote, or to participate in the deliberations of the Association, or to receive a copy of the proceedings.

52. Any member whose dues shall remain unpaid for a term of three years may be dropped from the roll of membership by a vote of the Council.

A. B. SLATER, JR., Secretary.

BRIEFLY TOLD.

THE ST. LOUIS MEETING OF THE AMERICAN ASSOCIATION.—Next week the 24th annual meeting of the American Association will have been completed, and the Association will have gone into its quarter century mark, which fact will cause the veterans to become doubly appreciative that time flies. So far as careful application of prevision is concerned, the officers charged with the duty of preparing for the meeting are to be credited with having performed their whole obligations in respect of those who named them to conduct the Association's affairs. Secretary Slater's notices show just what has been done and that which the members may expect from the technical points of the meeting; and the reinforcement of the set paper list by a table of short topics for general discussion is bound to add to the attractiveness of the sessions from the technical standpoint. In view of the work performed by President Humphreys and his aides it is hoped that their best reward will be freely accorded them, which best reward is nothing more nor less than an attendance numerically high and imposingly representative. The Eastern contingent, to leave from New York, by way of the Pennsylvania Railroad, at 2 P.M., of the 25th inst., has reached fair number at time of writing, and the prospect is that many more will declare their intention to join the party before the named day and hour are at hand. We understand that no special car will be engaged to carry the "Middle West" delegates from Chicago to St. Louis; but many of the Chicago delegates have informally agreed to make the trip on the Chicago and Alton Road, taking the train leaving Chicago at 11:30 P.M. of the 26th inst. Nothing much can now be said about the entertainment programme, the members of the local Committee of Arrangements preferring that the scheme shall be unpublished until the members are at hand to look it over on joint account with the committee.

PROGRESS IN THE MATTER OF THE AMERICAN EXHIBITION OF GAS APPLIANCES.—Applications by intending exhibitors for space at the announced exhibition of gas appliances, at the Madison Square Garden, this city, next January and February, under the auspices of the Gas Industries Company, were opened on the 15th inst., and the number of applications must have been very gratifying to the gentlemen in charge of the enterprise. In fact, the applications, both in respect of number and solidity, go a great way to prove that the exhibition is to be representative of the present standing of the American gas industry. In a communication to us, bearing date of the 14th inst., Mr. E. C. Brown, Chairman of the Executive Committee of the Company, assures us that "As a matter of fact, in the case of this Company the President [meaning Prof. Chas. F. Chandler] is by reason of his office a member of the Executive Committee." This specific affirmation is especially gratifying, since it goes to show that the Professor is to take an active and not a passive part in a display that ought to be of great value to our industry. The New England Association of Gas Engineers has named Mr. Charles H. Nettleton, of the Derby Gas Company, of Birmingham, Conn., to represent it at the Exhibition. Another novel proposition in connection with Association representation is one emanating from Mr. Irvin Butterworth, of the Ohio Association, already named by that Association as its official representative for the exhibition. Mr. Butterworth has addressed a communication to each member of the Ohio Association, in which he asks the recipients to answer "Yes" or "No" to the question whether the Association should hold its next annual meeting in New York, during the progress of the exhibition, instead of in Cleveland, Ohio, in March next, as would be the case under the operation of normal conditions. The suggestion is certainly a novel one; and we think it likely will not be received with favor by the Ohio Association members; for they as gas men are pretty well informed now about what may be accomplished by and through gas as a lighting, heating and power agent. However, the Ohio Association can be trusted safely to do that which is to the best advantage for its membership.

OBITUARY NOTE—MR. FREDERICK TIFFANY STORY.—We regret to be called upon to report the death of Mr. Frederick Tiffany Story, who passed away, on the evening of the 8th inst., at his home in Watertown, N. Y., an honored resident of which place he had been for over 50 years. To the present generation of gas men, even in this section of the country, Mr. Story may have been comparatively unknown, but the cold fact remains that he was the pioneer representative of the industry in Northern New York, he having (1852) organized the Watertown Gas Light Company, that started business with a rosin gas plant and a selling rate of $7 per 1,000. Since then, under his careful, conservative and honest direction, the Company prospered; for at the time of his death he was still in harness, as its President and Treasurer. His history is a simple, straightforward one. He was born (1824) in Cherry Valley, Otsego county, N. Y., of which district his progenitors were noted residents. Having acquired an education, his first attempt to gain a livelihood and name was made in connection with the surveys for the Erie Canal, but opportunity came to him shortly after this connection which enabled him to engage in mercantile pursuits in Watertown (1844.) He prospered, and in 1852, as noted above, he organized the Watertown Gas Light Company, the fortunes of which have since been those of his own; for to its advancement his later lifetime was given. In 1853 he was united in marriage to Miss Harriet Smith (daughter of Major Henry Smith, U.S.A), who survives him. He was religious (he served Watertown Trinity Church, of Watertown, as a vestryman for 25 years) without being intolerant; charitable without ostentation, and equitable and thorough in his business life. For the main facts in this brief notice we are indebted to Mr. H. C. Whitney, Secretary of the Watertown Company.

[A paper by Dr. E. Bergmann.]

The Formation of Cyanogen from Ammonia.

[Translated from the German for the *Journal of Gas Lighting*.]

Since the time of Scheele and Gay-Lussac, cyanogen has been the subject of many researches, and its scientific and technical importance has made them particularly numerous during the last ten years. Nitrogen is the most important constituent in regard to the formation of cyanogen; and it is available either free or combined. The formation of cyanogen from free nitrogen is the most curious, since nitrogen is distinguished from other elements by its great inertness. On the large scale, however, cyanogen is formed from free nitrogen in blast furnaces, as Clark, Zincen and Bromeis, Redtenbacher and others pointed out many years ago. Lewis Thompson observed, in 1839, that more cyanide was formed when coke or coal was fluxed with potash and iron filings at a red heat if air was admitted, than if the air was excluded, and such formation appeared to be independent of the amount of nitrogen in the carbonaceous matter. Fownes found by experiment that free nitrogen can unite with carbon at a high temperature, provided a substance is present which forms a stable non-volatile cyanide. Erd mann and Marchand, as well as Delbrück, so far confirmed Fownes' experiments that they obtained proof of the formation of cyanogen, though in inconsiderable quantity, by heating to incandescence potassium carbonate with sugar charcoal.

Bunsen and Playfair were the first to fully explain the processes resulting in the production of cyanogen in blast furnaces. They showed, by experiments on pure materials—namely, sugar charcoal and potash, which yielded no trace of cyanogen in carbonic acid—that the cyanogen compounds formed obtained their nitrogen from the air. They proved also that potassium cyanide was formed when the atmosphere in which the experiments were conducted consisted of nitrogen. They concluded that nitrogen was freely absorbed by the mixture of sugar charcoal and potash, so long as the temperature was maintained at that at which potassium is formed by reduction; but that no absorption occurred at a lower temperature. Rieken independently also came to the conclusion that it was necessary that the temperature of the reduction of potash should be maintained, and that the stream of nitrogen should be heated to a like temperature. Berthelot produced hydrocyanic acid from a mixture of acetylene and nitrogen by the aid of the electric spark; the acetylene having been formed in like manner from carbon and hydrogen. He obtained it also from nitrogen and ethylene or hexylene; but in these cases, there was an intermediate production of acetylene. Ber thelot considered that potassium cyanide was produced through a previous formation of potassium carbide (C_2K_2) from the acetylene, and the subsequent absorption of nitrogen by that body. Briegleb and Geuther formed cyanogen from magnesium nitride and carbon. The nitride was formed by heating magnesium filings in nitrogen. Cyanogen could similarly be obtained through the nitrides of other metals.

Oxygen compounds of nitrogen may also yield cyanogen. Kuhlmann found that ethylene, led over heated platinum sponge with excess of nitric oxide, formed ammonium cyanide and carbonic acid. Cyanogen was also formed by passing nitric oxide and alcohol vapor over platinum sponge above 400° C. The formation of cyanogen from nitro geneous organic substances is of more general interest. The fact that such substances, when fluxed with potash, give cyanide, forms the basis of the potassium ferrocyanide manufacture. The spent oxide of gas works has now established itself as a valuable source of cyanogen compounds, and the old process has been almost given up in Germany. Liebig considered that, by heating nitrogenous constituents with alkali, there was a partial formation of ammonia, which was then converted by incandescent carbon into ammonium or potassium cyanide, and that the non-volatile nitrogen remaining in the coal combined with the alkali and carbon to produce potassium cyanide. This formation of cyanogen is of importance in the analytical detection of nitrogen in organic bodies.

Scheele formed potassium cyanide by heating sal ammoniac and graphite with potassium carbonate. Clouet found that a substance soluble in water, and with an odor of bitter almonds, was produced on leading ammonia over incandescent carbon. Langlois passed dr e l ammonia through an incandescent porcelain tube filled with wood charcoal, and obtained as products ammonium cyanide and hydrogen. Kuhlmann produced ammonium cyanide by leading ammonia and carbonic oxide over spongy platinum. He then obtained ammonium cyanide from ammonia and incandescent carbon; and he asserted that methane was formed at the same time. Weltzein did not obtain the latter on repeating the experiments, and his yield of cyanogen was less; but he used a glass tube, and could not therefore employ a sufficiently high temperature. The technical importance of cyanogen has been immensely extended by the use of its compounds in electrotyping and gold extraction. The M'Arthur-Forrest process for extracting gold has caused an extraordinary demand for potassium cyanide.

The present work deals with the formation of cyanogen from ammonia and incandescent charcoal. The papers of Langlois, Kuhlmann, and Weltzien give no detailed accounts of the conditions of their experiments; while their statements are contradictory, and quantitative results are lacking. The researches suggested by Dr. Bunte have in part been carried out by Dr. Bueb; and as his results have not yet been published, they may be briefly given here. His experiments were on the action of ammonia on charcoal at different temperatures—viz., 800°, 1,000°, and 1,150° to 1,180° C. (1,472°, 1,832°, and 2,102° to 2,156° F.) The charcoal was heated in a porcelain tube, since iron decomposes cyanogen. At 800° C., only about 4 per cent. of the ammoniacal nitrogen was converted into hydrocyanic acid; but at 1,000° C., the percentage had increased to 24, and the rest of the ammonia had almost completely broken up into nitrogen and hydrogen. But if a mixture of coal gas and ammonia, in place of ammonia only, was passed over the incandescent charcoal at a temperature of 1,150°—1,180° C., 60 per cent. of the ammoniacal nitrogen was converted intro hydrocyanic acid, 20 per cent. was decomposed into hydrogen and nitrogen, and 20 per cent. remained unchanged. Those results presented sufficient inducement for a more thorough investigation; and the author set himself to ascertain by quantitative researches: (1) What influence coal gas has on the behavior of ammonia towards incandescent charcoal. (2) What is its behavior if other gases—such as carbonic oxide, a mixture of nitrogen and carbonic oxide, or of nitrogen and hydrogen—are substituted for the coal gas? (3) What temperatures are most favorable for the formation of cyanogen under these experimental conditions?

There are two possible ways in which the coal gas may behave—either as an indifferent diluent of the ammonia, or by separation of carbon, it may act chemically on the ammonia according to the equation $C_2 + 2NH_3 = 2CNH + 2H_2$. If this action occurs, a greater separation of carbon, which might be effected by the use of carbureted gas, would bring about a greater yield of cyanogen. To solve the question, coal gas and ammonia were passed over incandescent carbon in one set of experiments; and coal gas, carbureted with pentane, and ammonia were passed over it in a second set of experiments. The pentane did not cause an increase in the amount of cyanogen formed.

The experiments on the second question might be expected to show a greater formation of cyanogen when carbonic oxide was applied, from the probability of the following reaction taking place: $CO + NH_3 = CNH + H_2O$. Kuhlmann, indeed, obtained such a double decomposition over spongy platinum; and to ascertain whether it occurred over incandescent charcoal, both carbonic oxide and generator gas mixed with ammonia were passed over the latter, and also, for the sake of comparison, a mixture of nitrogen, hydrogen, and ammonia, free from carbonic oxide. The result was a more or less heavy deposition of carbon in the tube, which pointed to a decomposition of cyanogen. The experiments were repeated at lower temperatures, and finally tests were made on the action of ammonia on carbonic oxide in the absence of the charcoal.

The apparatus employed for the experiments consisted of a gas-holder, followed by a meter and a desiccating vessel; an ammonia evolution flask, with potash drying-tube attached; a porcelain tube containing wood charcoal: three U-shaped absorption tubes; and an aspirating bottle. The gas was led from the holder through caustic potash, which removed the moisture, into the ammonia evolution flask, whence it passed through the incandescent porcelain tube, packed with pieces of charcoal about the size of peas. The products of the reaction then passed into bulbed U-tubes, charged with solution of potash free from chlorine. In these, the hydrocyanic acid and a great part of the unchanged ammonia were absorbed, the remainder of the latter being taken up by normal sulphuric acid. The unabsorbed gases were collected in the aspirator, and their volume and composition ascertained. The porcelain tube was heated by means of a Fletcher's blast furnace, which would give a temperature of nearly 1,200° C. (2,192° F.). Prinseps' alloys of silver, gold and platinum were used, to determine the actual temperature in particular experiments. The alloys used had the following percentage compositions and melting points:

Silver	100	60	40	20	..	..	..	..	..
Gold	..	40	60	80	100	95	90	85	80
Platinum.....	..	..	..	..	..	5	10	15	20
Melting-point, °C.....	954	995	1020	1045	1075	1100	1130	1160	1190

These alloys were compared with the temperatures shown by Wi-

borg's air thermometer. For use strips were fused up separately in difficultly fusible glass, in order that they might not be acted upon, and their melting points consequently affected. Recognition of the different alloys was ensured by giving the glass tubes various shapes—*i. e.*, pointed or round ends, etc. The separation by fusion of the more easily fusible components of the alloy, which is very noticeable at temperatures above 1,300°, was not perceptible with the alloys employed in this instance. The amount of ammonia used was ascertained from the loss in weight of the ammonia evolution flask and the following potash tube, which were weighed before and after each test. It could also be ascertained by drawing off from a side arm in the tube leading to the porcelain tube about 3 liters of the ammoniacal gaseous mixture. This was drawn through 10 c.c. of normal sulphuric acid, into an aspirating vessel, until the methyl-orange with which the acid was tinted showed that it was neutralized, when the volume of gas drawn into the aspirator was ascertained and the percentage of the ammonia in the mixture was found by calculation.

In making the tests, errors due to the space within the train of vessels being filled with air were avoided by displacing the air in the combustion tube and the apparatus anterior to it by gas of similar composition to that on which the test was to be made. When the air had thus been displaced, the weighed tubes and aspirator were coupled up to the combustion tube. The nitrogen of the ammonia was found in three products—viz.: (1) Hydrocyanic acid, collected as potassium cyanide; (2) ammonia which had escaped change; (3) free nitrogen from decomposition effected at the high temperature.

The hydrocyanic acid was determined by making up the potash solution from the tubes to 500 c.c., and titrating an aliquot part, after neutralization with dilute nitric acid, with decinormal solution of silver. The ammonia was determined by distilling another aliquot part of the potash solution, and receiving the distillate in normal sulphuric acid, which was afterwards titrated back with normal alkali. The ammonia which passed on into the last tube charged with normal sulphuric acid was determined by simply titrating the latter. In the tests made with coal gas, the nitrogen set free was calculated merely by difference, as the variable percentage in coal gas and the relatively small amount of ammonia decomposed, prevented any exact direct method being found. In the tests with carbonic oxide and generator gas, the nitrogen formed by decomposition of ammonia was calculated from the amount of hydrogen produced in like manner. After ascertaining the volume, the gas in the aspirator was analyzed by the Bunte burette, in order to determine the percentage of hydrogen for this purpose. The decomposition of the ammonia may take place according to the equations—

(1) $C + NH_3 = CNH + H_2$; and (2) $2NH_3 = N_2 + 3H_2$.

By the first equation, two volumes of hydrogen are set free for every two volumes of hydrocyanic acid; and by the second, three volumes of hydrogen correspond to two volumes of ammonia which have been decomposed, but have not formed cyanogen. The proportions by volume would remain the same, even if carbonic oxide entered into the reaction; thus—

(1) $CO + NH_3 = CNH + H_2O$ and $C + H_2O = CO + H_2$.
(2) $2NH_3 = N_2 + 3H_2O$.

Therefore, taking the total volume of hydrogen found by analysis as= a, the hydrogen set free according to equation (1), calculated from the hydrocyanic acid formed as = b, the nitrogen = x is found, expressed in grammes, by the equation—

$$x = \frac{a - b}{3} \times 1.25$$

[1.25 is the weight of a liter of nitrogen in grammes.]

This equation holds good if the decomposition extends to the already formed hydrocyanic acid; thus—

(1) $2NH_3 + C_2 = 2CNH + 2H_2$.
(2) $2CNH = C_2 + N_2 + H_2$; the value of b being in this case = 0.

The experiments may be classed in five groups, as follows: (1) The formation of cyanogen from ammonia, charcoal and coal gas. (2) The formation of cyanogen from ammonia, charcoal and carbureted coal gas. (3) The formation of cyanogen from ammonia, charcoal and carbonic oxide, as well as indifferent gases at 1,100° C. and over. (4) The formation of cyanogen from ammonia, charcoal, carbonic oxide and indifferent gases at temperatures approaching 1,000° C. (5) Experiments on ammonia and carbonic oxide without charcoal.

The experiments are described under these five headings.

I.—*Formation of Cyanogen from Ammonia and Charcoal with Coal Gas.*

The action of a mixture of coal gas and ammonia on charcoal was studied under the conditions which earlier experiments had shown to be most favorable to the formation of cyanogen—viz., at a temperature of from 1,100°—1,180° C. (2,012°—2,156° F.), and with gas containing about 10 per cent. of its volume of ammonia. Five experiments were made under conditions in which only the rate of flow of the gas through the porcelain tube was varied to a considerable extent. A digest of the results is given in Table I.

TABLE I.—*Formation of Cyanogen from Charcoal and Ammonia with Coal Gas.*

	Duration of the Experiment in Minutes.	Temperature in Degrees Centigrade.	Percentage by Volume of Ammonia in the Gaseous Mixture.	Grams of Ammonia Passed through the Tube per Hour.	Grams of Nitrogen Used in the Experiment.	Percentage of Nitrogen.		
						Found as Hydrocyanic Acid.	Found as Unchanged Ammonia.	Found as Gas (by difference.)
1	33	1,100	8.7	6 640	2.734	19.1	69.2	11.7
2	47	1,100	9.6	1.860	1.200	22.8	35.4	41.8
3	150	Under 1,040	12.0	0.863	1.776	31.0	51.0	18.0
4	180	1,100	13.0	0.329	0.815	46.6	21.0	32.4
5	185	1,100	14.0	0.269	0.666	52.5	19.0	28.5

The amount of ammonia per hour is highest in the first experiment; and 19 per cent. only of its nitrogen is converted to cyanogen. The amount of ammonia is lowest in the fifth experiment, and 52.5 per cent. of its nitrogen is converted to cyanogen. The cause of this difference must, as the other conditions varied but little, be looked for in the difference in the rate of flow of the gaseous mixture. The lower temperature in the third experiment appears to have been unfavorable to the breaking up of ammonia with liberation of nitrogen. The results of these experiments may be thus summarized: The rate at which ammonia diluted with coal gas is passed over incandescent charcoal has great influence on the formation of cyanogen; and the greater the rate of flow, the more ammonia escapes conversion. In the experiments detailed in Table I., the rate of flow of the gas was about 28 inches per second in No. 1; and the gas was one second passing through the sphere of action. The rate of flow was about 0.8 inch per second in No. 5, and the gas was 50 seconds passing through the sphere of reaction. The formation of cyanogen is greater at 1,100° C. (2,012° F.) than at 1,000° C. (1,832° F.) Experiments Nos. 4 and 5 show that ammonium cyanide does not result from passing ammonia over glowing charcoal, since, if it were formed, ammonia at least equivalent to the quantities of hydrocyanic acid would appear. In these instances, the occurrence of ammonium cyanide would have demanded the presence of 47 or 53 per cent. of nitrogen in the form of undecomposed ammonia, and these amounts were not found.

II.—*Formation of Cyanogen from Ammonia and Charcoal with Coal Gas and Pentane.*

The gas was carbureted by passage through a flask containing pentane; and the difference between the weights of the flask before and after the passage of the gas gave the amount of pentane taken up by it. At a sufficiently high temperature, the pentane, like the hydrocarbons of coal gas, may be broken up eventually into carbon and hydrogen, the ultimate decomposition being shown by the equation: $2C_5H_{12} = 5C_2 + 12H_2$. The experiments show that such complete decomposition does not occur at 1,100° C. (2,012° F.), and that the amount of decomposition varies with the rate of flow of the pentane vapor through the incandescent tube. At 1,100° C. a deep brown cloud appeared in the tubes and aspirator when the rate was high; but on moderating the rate of flow the cloud diminished. Tarry products separated in the tubes and aspirator, and therefore 1,100° C. did not suffice for the complete breaking up of the pentane.

Table II. presents a digest of the results of the experiments. The first two were at 1,045° C., and the mixtures contained about the same amount of ammonia. The first, however, contained very much more pentane than the second, and the results of the experiments on the two mixtures are very different—the first giving only 6 per cent. of cyanogen, against 37 per cent. in the second. The quantity of ammonia undecomposed falls in the second case to about half that in the first. These surprising results must evidently be ascribed to the difference in the amount of pentane in the gas. The proportion of pentane to ammonia in the third experiment was five times that in the fourth; but the proportion of cyanogen formed in the third was only 12 per cent., against 33 per cent. in the fourth. The undecomposed ammonia was 80 per cent. in the third, against 49 per cent. in the fourth, notwithstanding the high temperature in both cases. For the same tempera-

ture, therefore, the formation of cyanogen increases, and the proportion of undecomposed ammonia diminishes, with a diminution in the proportion of pentane. The explanation of this relation may be found in the great increase in volume of the gas which results from the decomposition of the pentane at the high temperature, and the consequent dilution of the ammonia. This dilution is tantamount to an increase in the rate of flow; and, therefore, according to the experiments on uncarbureted coal gas, should correspond to a smaller yield of cyanogen, and to the escape of more ammonia undecomposed. Carbon had separated freely from the pentane, as a graphitic deposit 1 m.m. (0.039 inch) in thickness was found in the tube. Dicyanogen could not be detected in the products of the reaction.

TABLE II.—*Formation of Cyanogen from Charcoal and Ammonia with Carbureted Coal Gas.*

	Duration of the Experiment in Minutes.	Temperature in Degrees Centigrade.	Liters of Coal Gas Used, at 0° C. and 760 m.m.	Liters of Pentane Vapor Added.	Percentage by Volume of Ammonia in the Gaseous Mixture.	Grammes of Ammonia Passed through the Tube per Hour.	Grammes of Nitrogen Used in the Experiment.	Percentage of Nitrogen		
								Found as Hydrocyanic Acid.	Found as Unchanged Ammonia.	Found as Gas (by Difference.)
1	120	1,045	12.0	4.0	13	0.908	1.690	6.0	61.0	33.0
2	150	1,045	8.4	1.2	14	0.504	1.037	37.0	31.0	32.0
3	40	1,100	13.7	6.2	20	5.580	3.063	12.5	80.4	7.1
4	45	1,100	26.0	1.6	22	7.880	4.860	32.8	49.3	17.9
5	135	1,130	6.0	1.8	15	0.432	0.791	30.0	44.0	26.0

Hydrocarbons, therefore, hinder the conversion of the ammonia, and a higher temperature than 1,100° C., or longer exposure to the incandescent carbon, is needed to effect it. The carbon separating from the hydrocarbons, which is in the so-called nascent state, does not increase the activity of the transformation.

III. *Formation of Cyanogen from Charcoal and Ammonia with Carbonic Oxide, Generator Gas and Mixtures of Nitrogen and Hydrogen.*

The carbonic oxide for the experiments was made from potassium ferrocyanide and strong sulphuric acid, and had the following average composition: Carbonic oxide, 94.5 per cent.; nitrogen, 4.9 per cent.; and oxygen, 0.6 per cent. This carbonic oxide was used in experiments 1, 3, 4, 5 and 7. In experiments 6 and 8 the gaseous residue from the passage of carbonic oxide and ammonia over the charcoal was used in place of carbonic oxide. It consisted of—

	Experiment 6.	Experiment 8.
Oxygen	0.8 per cent.	.. per cent.
Carbonic oxide..	67.3 "	28.0 "
Hydrogen.....	17.6 "	48.0 "
Nitrogen	14.3 "	24.0 "

In the second and ninth experiments, the mixture obtained by the decomposition of ammonia only was used. The chief results of nine experiments are given in Table III.

TABLE III.—*Formation of Cyanogen from Charcoal and Ammonia from Carbonic Oxide, Generator Gas and Mixtures of Nitrogen and Hydrogen.*

	Duration of Experiment in Minutes,	Temperature in Degrees Centigrade.	Percentage by Volume of Ammonia in the Gaseous Mixture.	Grams of Ammonia Passed through the Tube per Hour.	Grams of Nitrogen Used in the Experiment.	Percentage of Nitrogen.		
						Found as Cyanogen.	Found as Ammonia.	Found as such.
1	60	1,130 Above	46	16.03	13.200	28.1	2.5	63.2
2	60	1,020	37	7.90	6.500	33.4	2.1	62.0
3	80	1,100	17	4.98	5.470	39.9	7.0	48.2
4	60	1,100	17	6.00	5.020	42.0	4.0	62.0
5	50	1,130	17	6.90	4.790	39.5	2.6	57.0
6	33	1,130	17	12.80	5.300	36.2	4.0	56.0
7	95	1,130	10	2.58	3.200	44.2	5.0	51.0
8	45	1,100	8	2.04	1.262	56.4	8.0	36.7
9	66	1,160	5	2.00	2.340	43.7	10.8	45.5
10	40	950	33	—	10.050	21.2	54.7	24.1
11	130	950 Under	17	—	5.200	28.5	48.0	23.5
12	75	950	11	—	2.960	23.7	42.0	34.3
13	60	1,020	7	—	1.600	43.8	31.0	25.2

The main difference in the conditions was the variation of the proportion of ammonia in the gas used; and differences in the results are most evident on a comparison of experiments 1 and 2 with 8. It would appear that the quantity of cyanogen formed increases with the dilution of the ammonia by other gases. The quantities of ammonia undecomposed range from 2 to 11 per cent. in the different experiments, and are therefore much less than those found in the experiments with coal gas and coal gas and pentane. This shows that the theory held by Langlois, Kuhlmann and St. Cl. Deville, that ammonium cyanide is stable at very high temperature, is untenable. The formation of cyanogen from ammonia in the presence of carbonic oxide, generator gas, etc., depends therefore in general on the same circumstances as its formation with coal gas; but there is a more considerable decomposition of the ammonia and also of hydrocyanic acid. The decomposition was greatest in the first two experiments, where the ammonia was comparatively concentrated; and least in experiment 8, where the gas contained only about 8 per cent. of its volume of ammonia. The extent to which decomposition took place was shown by the volume of gas collected in the aspirator, which was double that of the gas introduced in the first two experiments, and was less in the subsequent ones. The increased volume could only be due to decomposition of ammonia and hydrocyanic acid, as the formation of hydrocarbons and methane could not be proved. The composition of the gas gave no indication of whether the nitrogen and hydrogen were derived from the direct dissociation of ammonia or from hydrocyanic acid formed from it, as in either case three molecules of hydrogen would be found for every two molecules of ammonia. But it was evident that decomposition of hydrocyanic acid had taken place, as a sooty deposit was found on the porcelain boat for the Prinseps' alloy, and also on the charcoal. This was especially noticeable in experiments 1 and 2. No formation of dicyanogen occurred, as its characteristic purple red flame was not produced when the gas passing out of the porcelain tube was ignited. This fact is also supported by the figures in Table III., which gives the principal results of the experiments, as also of those described in Section IV.

IV. *Formation of Cyanogen from Ammonia and Charcoal with Carbonic Oxide and Nitrogen (Generator Gas) and Indifferent Gases at 950°–1,020° C.*

Four experiments were made at lower temperatures than those used in earlier researches; and details of the results are given in Table III. (experiments 10, 11, 12 and 13). The gases used were: In 10, 12 and 13 a mixture of hydrogen and nitrogen; and in 11, generator gas. The quantity of ammonia introduced decreases in the experiments in the order in which they are given. The hydrocyanic acid formed varies from 21 to 44 per cent., and the unchanged ammonia from 31 to 55 per cent. The formation of cyanogen is greater the more dilute the ammonia, except in experiment 12, where the temperature was low. Deposits of carbon were not observed as in the experiments at higher temperatures, and there was no extensive decomposition of the hydrocyanic acid formed. Higher temperatures than 1,000° C. (1,832° F.), therefore, give a greater formation of cyanogen, but at the same time cause greater decomposition of the ammonia and hydrocyanic acid already formed. One important fact became clear from the results in Table III., namely, that reaction between carbonic oxide and ammonia, resulting in extensive production of cyanogen, did not occur at high temperatures, as had been expected. A comparison of experiments 1 and 2 in Table III. makes this fact clear.

V. *Experiments with Ammonia and Carbonic Oxide without Intervention of Charcoal.*

These experiments were undertaken to ascertain whether at high temperatures carbonic oxide acted on ammonia and produced cyanogen, when the charcoal in the tube was replaced by pieces of porcelain. The gas used was generator gas, containing, in experiment 1, 27.3 per cent., and in experiment 2, 12.7 per cent., of carbonic oxide. A temperature of about 1,100° C. was used; and each of the experiments lasted one hour. There was 18 per cent in the first, and 30 per cent. in the second, of ammonia in the gas by volume; and therefore 5.17 grammes, and 12.75 grammes of ammonia passed through the tube in an hour. Of the nitrogen admitted, 0.6 and 0.4 per cent. became cyanogen, 32.5 and 62.2 per cent. remained as ammonia, and 68.0 and 34.0 per cent. was free. The formation of cyanogen, therefore, does take place, though to a very limited extent. No soot was found deposited on the porcelain, showing that no breaking up of cyanogen had occurred.

The results of the work described above may be summarized thus:

1. By leading ammonia over glowing charcoal, hydrocyanic acid,

and not ammonia cyanide, is formed. Nitrogen and hydrogen also occur, but methane never does.

2. Dilution of the ammonia with coal gas effects an increase in the cyanogen formed, and also a decrease in the amount of ammonia broken up to nitrogen and hydrogen.

3. The introduction of high molecular hydrocarbons, in contrast to 2, diminishes the yield of cyanogen in consequence of the protection to the ammonia afforded by the splitting up of the hydrocarbons at high temperatures. Nascent carbon, therefore, is not active.

4. The rate at which ammonia diluted with coal gas is led over charcoal, has much influence on the conversion. The greater the speed, the less cyanogen is formed, and the more ammonia passes on unchanged.

5. If carbonic oxide is used in place of coal gas for diluting the ammonia, cyanogen is formed to about the same extent; but there is a greater decomposition into nitrogen and hydrogen. The same occurs if generator gas or a mixture of nitrogen and hydrogen takes the place of the carbonic oxide.

6. The greater yield of cyanogen obtained when the ammonia is diluted with other gases is not due to a chemical interaction of the gases and ammonia, but solely to the diluted ammonia being better able to resist resolution into hydrogen and nitrogen than undiluted. The greater the proportion of ammonia in the gaseous mixture, the greater is the amount which is thus resolved.

7. The most favorable temperature for formation of cyanogen varies according to the nature of the diluent. With carbonic oxide, generator gas, and mixtures of nitrogen and hydrogen, it lies between 1 000° C. and 1,100° C. With mixtures containing hydrocarbons, the lower limit at least approaches 1,100° C. The more hydrocarbons, and the higher the number of atoms in their molecules, the more ammonia escapes decomposition at this temperature.

Electrical Distribution.

[Abstracted from the address of Dr. Louis Duncan before the American Institute of Electrical Engineers.]

The distribution of electrical energy to consumers, as distinguished from its transmission to long distances, has been largely accomplished by the agency of continuous currents, although alternating currents have played an important part in incandescent lighting. As I have stated, a considerable proportion of current for lighting is distributed at constant potential on the 3 wire system, or at constant current on arc light circuits, while power for traction circuits is distributed at approximately constant potential at an average of say 550 volts.

I shall first consider the condition of affairs in a traction system in a large city, where a number of suburban lines are operated. If direct distribution is attempted from a single station, it will be found that when the distance exceeds 5 or 6 miles a large amount of copper must be employed to prevent both excessive loss and excessive variation of potential on the lines. On suburban lines it is the latter consideration that usually determines the amount of copper used, and this is especially true on lines where there is a considerable excursion traffic. Even in the city itself, the supplying of sections at distances 3 or 4 miles from the station may require so much copper that it would be less expensive to operate separate stations. Several methods other than the direct method may be employed to remedy these difficulties. For outlying lines where the traffic is mainly of the excursion order, being variable both for the day and for different seasons, boosters may be advantageously used. It is perhaps best from reasons of economy to run the boosting dynamos from motors. These dynamos are series wound and are connected to feeders of such resistance that the fall of potential in the wire for a given current is compensated for by the rise in voltage of the booster. There is a decreased cost of copper incidental to this system, due to the fact that the drop is not limited by considerations of regulation—the voltage at the end of the feeder being constant—while the transmission is at an increased potential. If the average station potential is 600 volts, and it is boosted 300 volts, then the copper for a given loss would be decreased in the ratio of 36 to 81. The booster system has the advantage of the direct system when the cost of the additional apparatus, together with the increased loss on the line, capitalized, is less than the increased cost of the copper necessary to produce the same result by the direct system. Whether the balance is in favor of one or the other depends on the distance and the variation of the load, and it is indifferent whether the variation in the latter occurs often or not.

If any transforming device is employed to feed a distant section of the line it must be remembered that the capacity of the device must be great enough to look out for the maximum demand on this section. Suppose now that we wish to feed some suburban line where the load has considerable momentary fluctuations but where the traffic is moderately constant during the year. In this case the booster could be used with a storage battery at the end of its feeder, the battery supplying the line. The advantages of this combination are greater than with the simple booster, and in many cases they will compensate for the interest and depreciation on the battery and the loss in it. If the arrangement is properly made, the load on the booster and line wire will be practically constant, thus decreasing the capacity of the booster to that required for the average load, while less copper will be required for a given loss. As to the latter point, suppose a given amount of power is to be distributed in 24 hours, say 200 amperes at 600 volts, if the load is uniform, the loss will be proportional to $200^2 \times 24$ hours. If it is all distributed in 12 hours, the loss will be proportional to $400^2 \times 12$ hours, or twice as much. So in the case of the steady load the same power could be transmitted with the same loss with half the copper. It makes no difference whether the variation extends over 12 hours in 24 or it occurs every other minute, the result will be the same. It is apparent then that it is of the utmost importance to keep the line steadily loaded, as well as the station, and this points to the location of the battery near the points of consumption and not in the station. By this system—a booster with storage batteries—it is possible, assuming the same loss, to transmit power to a distance of 10 miles with approximately the same amount of copper that would be required for a 5-mile transmission on the direct system. It would increase the economical radius of distribution twice and the area of distribution four times. A single station could economically supply lines within distances up to 10 or 12 miles. If it is desired to still further increase the radius of distribution, it is possible to do this by employing some of the alternating current methods that have come into use. I will discuss these methods later, but at this point I may remark that the use of stationary rotary transformers permits the energy to be transmitted in the form of alternating currents, and to be changed again into continuous currents of any required voltage. These rotary transformers supplied by an alternating current which is transmitted from the station at a high voltage, may be used to feed the line directly, or they may be used to supply storage batteries which are connected to the line. In the latter case we have the advantage of decreased size of apparatus, of steady load on the station, and of a minimum cost of copper on the line; which system it would be best to employ would depend upon the distances and the character of the line and load.

Of the systems that I have proposed for city and suburban distribution from a single station three have been successfully employed, namely, the booster system; the booster system with batteries and rotary transformers operating directly on the line. When we consider the advantages of a single station and a steady load, it seems evident to me that many of the large traction systems would do well to concentrate their stations into one and to use the booster system with batteries for their outlying lines, and if necessary use rotary transformers for lines beyond the limit of ordinary suburban work. As to the possibility of the complete shut down of such a station, we have reached such a point in the construction of machinery, both electric and mechanical, that with a proper reserve, a careful system of duplex steam piping, and with fireproof construction of the station, such a possibility may be disregarded; while the batteries would look out for any momentary interruption on the feeders.

Some of the most important stations supplying incandescent lamps are operated on the three-wire continuous current system. In the last few years a considerable advance has been made in the sale of power for motors from these stations, and this has increased the revenue and has given better average output. The tendency in this country has been in the direction of using storage batteries in such stations, and abroad practically every continuous current station uses batteries. As in the case of traction systems it has been the custom in large cities to build a number of separate stations instead of building a single plant and distributing from it. The batteries have been placed in the stations themselves and no attempt has been made to decrease the amount of copper used by employing a number of centers of distribution and giving the main feeders a steady load. The same considerations that apply to stations for traction work will also apply to stations used to supply lights and the same methods of distribution may be used. It would unquestionably be more economical, in many instances, to use single stations, to transmit power from these stations to centers of distribution, where batteries may be located and to distribute from these centers on a three-wire system. A case in point is the system used at Buda Pesth, where the energy is distributed from the central station to

rotary transformers at sub stations, these rotary transformers feeding batteries, current being distributed from these batteries on a three-wire system. The reports of the operation of this station show that it is both economical and successful, and it might well be copied by some of the companies in this country. The gross receipts of some of the large illuminating companies bear such a large proportion to the company's stock that a comparatively small saving in operation would mean a considerable increase in the dividends, and there is no doubt in my mind that by using one power station, with battery sub-stations for distribution, that the operating expenses can be considerably decreased.

Alternating currents have been employed for lighting in this country, and they have been especially valuable where a district is to be supplied in which the distances are considerable as compared with a number of customers. It has been almost the universal custom to supply small transformers for each consumer, and while the average size of transformers is greater now than it was a few years ago, yet they are comparatively small. No power has been supplied from such stations, and although alternating arc lamps are used to a limited extent, yet the number is not increasing, and in some cases continuous current arc lamps have been substituted for the alternating. Under these conditions the load on the station is even more variable than in the case of a continuous current supply where motors may be employed, and the constant loss due to the large number of small transformers used, places this system at a disadvantage as compared with the continuous current system. The great advantage it possesses lies in the increased area of distribution rendered possible by the high voltages that are used, together with the possibility of locating the stations where power can be cheaply made. Abroad in the last few years most of the new stations that have been built use continuous currents, although some years ago the greater proportion of them were alternating current stations. It is also the custom abroad to use sub-stations with large transformers for distribution, thus doing away with a considerable part of the constant loss due to the small transformers used here. It is not possible, at the present time, without greatly complicating the system, to obtain a steady load on the station, and the only question that arises is the value of sub-stations, and the possibility of using some form of alternating current other than the single-phase.

The Use of Old Rails as Underground Conductors.

By Mr. F. O. Rusling.

While the writer was the Superintendent of the Buffalo (N. Y.) Railway Company, serious indications of electrolysis of the pipes within a half mile of the power house made it necessary to call in expert advice to put a stop to the trouble. A careful and thorough electrical survey was made of the entire district. This was a long and difficult matter, since there were three systems of natural gas pipes, two of illuminating gas, one of water and two conduit systems.

Although the pipes were already connected to the negative bus-bar by large copper cables, it was found that these were entirely inadequate, and that there were two points where the pipes at heavy load were 3 to 5 volts positive to the adjacent rails. One of these points was 1,500 feet north and the other 1,800 feet east of the power house.

The expert calculated that, until extensive changes could be made in rail returns, the former point would deliver about 1,000 amperes and the latter about 3,000. To bring this current to the dynamos with but 5 volts loss would need over $8,000 worth of copper. While hesitating over this large expenditure it occurred to us that there were about 300 tons of old tram rails on hand that might be used for the purpose. These were flat, center-bearing rails, originally weighing 56 pounds to the yard, but worn down to 50 pounds or less; they were high in carbon, hard and brittle.

The best scrap price obtainable was $8 per ton, delivered. Our expert carefully tested their conductivity with 1,000 to 1,500 amperes, using an instrument reading to 1-1000ths of a volt in order to secure accuracy. As the showing was satisfactory, he persuaded us to let him try the rails on the 1,500 feet length, which would require four rails in parallel to give the desired results.

As he guaranteed to bond them so as to make a continuous conductor, he was allowed to go ahead. A trench was dug between curb and sidewalk and a continuous trough of rough lumber put into it.

The rails were bolted together in pairs back to back, and arranged so that the end of one rail was at the center of its mate. The bonding was effected by scraping contact spots with a file near the end of each rail and amalgamating them with the Edison solid alloy. A steel washer ¼-inch thick, 1⅛-inch inside diameter, and 4-inch outside, was dipped into hot insulating compound and placed against one rail so as to inclose the contact spot. The hole in the washer was then filled with the Edison-Brown plastic alloy, inclosing an amalgamated steel spiral spring. The upper rail was then bolted on and the completed conductor lowered to bottom of trough, resting on one edge so that gravity would maintain the contacts. It will be evident that with this arrangement two of the bonds on any one rail would have to give way before the circuit could be broken; each bond was made sufficient to transmit 1,500 amperes. When the second set of rails was lowered into place, the trough was filled with a hot insulating compound and a cover nailed down. This compound was cheaper and better than asphaltum; it remains viscous even in cold weather and has high insulating qualities. It is a product of petroleum distillation much lighter than asphaltum and costing about $25 a ton.

This four-rail conduit was connected up and carried at heavy load, 1,100 amperes, 1,500 feet with a loss of but four volts. This result was so surprising that our expert suspected his instruments were wrong and sent them back to Weston for recalibration; they were returned, but proved that the measurements were correct. To appreciate the magnificent performance of these old rails and their bonds I need only say that, to give the same result, it would require 3.55 square inches of copper, and 1,500 feet of this would weigh 20,532 pounds and cost at 12 cents per pound, $2,462.83. Our four-rail lengths weighed 50 tons and cost as scrap but $400.00. The resistance of steel as compared with copper is usually considered to be between 7 to 1 and 9 to 1, but this including 50 bonds in each length was about 5.63 to 1. The tests proved that the plastic bonds actually did make an "electrically continuous rail," and after a year's service they are still maintaining their conductivity. This is more than can be said of any copper bond ever used. It will be noted that steel like this, even at $30.00 per ton, would be cheaper than copper as a conductor.

Our expert was then told to go ahead with the 14-rail conduit. As the steel was so hard and brittle, a great deal of time was required to file the contact spots and to bore holes for the bolts to hold them together, so another method was adopted. In the power house is an air compressor for cleaning out armatures and removing dust from the boiler house walls. An iron pipe was connected from the air reservoir to the yard and a single layer of rails, bottom up, was put on each wagon. Each load was carried into the yard and the contact spots were rapidly cleaned with a reciprocating pneumatic tool, borrowed from a boiler shop. To avoid drilling the rails, pieces of ¾-inch iron, about 24 inches by 8 inches, were placed in the trough every 15 feet.

These were bored at the ends for a pair of countersank ¾ inch bolts and had four contact spots cleaned with an emery wheel. On these were laid the plastic bonds and four rails side by side, with base down.

The spaces between the treads were just right for a second layer of three rails bottom side up. Then another set of bonds and an iron plate ¼ inch thick, 20 inches by 8 inches. On these more bonds, other layers of four and three rails and finally a ¾-inch by 24 inches by 8 inches top, bolting all layers together. The sides of the trough were but ½ inch from the rails between clamps, so as to save wasting insulating compound, with wider spaces to accommodate the clamps. Rail joints were broken as before.

This construction allowed very rapid and satisfactory work compared with the first. The performance was also satisfactory, as the 14 rails transmitted 3,250 amperes 1,800 feet with but four volts drop; an insulated pilot wire was put down with this conduit and permanently connected with a voltmeter in the power house. The rails used in this conduit weigh about 210 tons, which at $8.00 would amount to $1,680.

It would require 12.48 square inches of copper to equal the 70 square inches of steel. This copper, figured at 1,000 feet by one square inch, weighing 3,854.2 pounds, would weigh 86,580 pounds, and at 12 cents per pound would cost $10,389. The total cost of the rails and bonds for both conduits was about $3,322, as against $12,852 for equivalent copper. The labor to install the copper would of course be less, but on the other hand we had the rails in stock and the only actual outlay was for labor, bonds, lumber, bolts, and insulating material. I have not the details of these now at hand; my recollection is that the total expenditure did not exceed $2,500, and that we thus secured results which would otherwise have cost nearly $15,000.

From my experience with copper bonds I should not advise the use of buried rails for conduits if copper is used for connections.

Even when new it is impossible to get the full conductivity of the rail, and the contacts get worse and worse as time passes.

The copper when covered with the damp earth will oxidize at a rate

determined by the composition of the soil and the amount of current transmitted.

But following the lines indicated on our second rail conduit, any road with a lot of old rails on hand can cut down its transmission losses at a slight cost. This subject is well worth careful consideration on the part of railway managers.

Tests of Glow Lamps.

At the last meeting of the British Association a communication on this subject was presented by Mr. W. H. Preece, and it came in for a good share of attention. We have not received the text of it, and the following summaries of the paper and the subsequent discussion are from *Engineering*:

The author, in accordance with his custom, did not confine himself himself to written text, but rather discoursed on the subject he had selected. In Mr. Preece's case this practice—generally to be condemned—is not objectionable, for he has much self-possession and a ready delivery, qualities which enable him to preserve the thread of his narrative, and to say what he has to say without those painful waits, or hummings and hawings, with which so many speakers have to eke out their discourse, and which jar so unpleasantly on the nerves of an audience. The results Mr. Preece laid before the section were based on a vast number of trials he had made to test the qualities of various glow lamps. The details of these tests were contained in an elaborate series of tables which were put before the meeting, and were also shown graphically by diagrams which had been prepared. The whole form a most instructive history of the subject, and show how far wide of the mark are conclusions that have been drawn and accepted in regard to the behavior of certain lamps. Mr. Preece's primary reason for undertaking the investigation was to test the quality of various glow lamps since the Edison-Swan patents collapsed, in order to establish a fair specification for Post Office requirements, and to find, if possible, an expeditious, as well as trustworthy, way of testing the efficiency and durability of lamps submitted in competition.

The following were the points aimed at:

Experiment 1.—To find the efficiency and life of 100 and 105 volt 16 and 8 candle power lamps in a trial of 2,000 hours' duration when kept alight continuously at a constant voltage, and the filaments at an approximately uniform temperature.

Experiment 2.—To ascertain the efficiency and life of lamps when similarly maintained at constant potential, but lighted for several consecutive hours daily, as in an ordinary installation.

Experiments 3 *and* 4.—Same as in 1 and 2, except that the duration of trial was limited to 1,000 hours.

Experiment 5.—To find the mean breaking voltage of filaments by gradually increasing the voltage of each lamp at about the same rate.

Experiment 6.—To see what the effect would be on similar filaments after being raised to three-fourths of their mean breaking voltage as found by 5.

The speaker explained the manner in which the experiments were carried out, giving details of the means employed to insure trustworthy results. The name of firms supplying lamps were given in the tables. There were about 20 different makes in all. We do not propose quoting here the names of the makers, as we are unable now to produce the whole of the data, and to leave out some part might lead to injustice being done to some. The whole of the tests were carried out with continuous current.

The curves on the diagrams produced at the meeting indicated four classes of lamps tested in the continuous lighting experiments: 1. Those that start at about their nominal candle power at a high efficiency, but very quickly show a decided falling off in candle power and efficiency and become practically useless in four or five hundred hours. 2. Those that start off at about their nominal candle power, give a useful light for about 1,000 hours, and then burn out. 3. Those that start in a similar manner but do not break. 4. Those that start off with a candle power below their nominal value and keep it up fairly steadily for 2,000 hours or more. With the first-class referred to frequent renewals will evidently be necessary; but Mr. Preece was of opinion that "a short life and a merry one" is a condition not without its advantages. Classes 2 and 3, however, he considers the most promising lamps for practical use. The lamps of class 4 scarcely admit of fair comparison with the others, as they never reach their nominal candle power. Throughout the prolonged tests of "continuous lighting" the candle power of each lamp gradually dropped, and the watts per candle rose.

In the next series of tests, those conducted over 1,000 hours, in several lamps the candle power at first increased and then diminished. In one case a so-called 100-volt 8-candle power lamp began at 5½ candles, and remained practically constant during the first 400 hours. It then gradually rose 10 per cent. to the 800th hour, after which the light slowly diminished to the starting luminosity, but the watts per candle were then higher than at the beginning of the trial.

In experiments 2 and 3 the lamps were rigidly mounted to prevent vibration. The so-called economical or high-efficiency lamps suffered more in breakage of filaments than those of about 3¼ watts per candle. The longest run was 1056½ hours, and the shortest 23¾ hours. Omitting these numbers, and others below 100, the average life of eight 16-candle power 105-volt lamps was 463.47 hours; and of three 8 candle power 100 volt lamps 556 hours.

Having obtained records of the efficiency and durability of various glow lamps under conditions of constant illumination and intermittent lighting, Mr. Preece proceeded to determine a quick and ready way of satisfactorily judging the quality of lamps. To obtain this end the voltage of several lamps was gradually run up for each lamp singly at a uniform rate until the filaments broke. At the moment of rupture the voltage, current and time of running up were noted. Before increasing the normal voltage the current was measured and the resistance calculated. The average breaking voltage of the filaments was found to be 230, and the time of running up was from 3½ to 4½ minutes.

The experiments with three-fourths of the breaking voltage (Experiment 6) were made to see what would be the effect on electrical efficiency, candle power, and the resistance of the same kind of lamps when slowly raised from normal potential to three-fourths of their mean breaking voltage. The details were given in the tables, and it is interesting to state that the candle power was found to be rather more after the filaments had been raised to a high temperature and re-tested at initial pressure.

The experiments above quoted may be taken to show that in the continuous lighting experiments the candle power fell about 30 per cent., and the watts per candle rose about 28 per cent. in 1,000 hours. In installation work, lamps of about 3¾ watts per candle, burning from 7 to 9 hours per day, behave as regards life and efficiency about the same as when giving continuous illumination; but high efficiency lamps deteriorate more quickly. That good 100 or 105-volt 16-candle power lamps, taking 3¼ watts per candle, should stand a gradual increase of pressure of direct current up to 225 or 280 volts in 3½ minutes before the filament breaks; that when regularly raised in 2½ minutes to 170 volts, and afterwards re-tested at ordinary voltage, the candle power should not be less than 14.4 nor higher than 18.6, while the watts per candle should not exceed 4.

Mr. Preece also gave particulars of the specification for glow lamps he has drawn up for use in the Post Office. The size is determined; the voltage, candle power and normal watts are to be marked on the lamp; the lamps to be tested for defective filaments; photometric tests and 2½ minutes' pressure test to be made.

In conclusion, Mr. Preece stated that the general results of his tests led him to the conclusion that the duration of lamps, as stated by some makers, could not be depended upon, especially those of a cheap quality. The best practical lamp was that of 60 watts 16-candle power.

The discussion on Mr. Preece's paper was opened by Mr. Graham Harris, who asked if it would have made any difference had the lamps been tested by alternate current in place of continuous current.

Professor Ayrton pointed out the necessity in cases of this kind of testing a large number of lamps in order to get a fair average result, and eliminate the chance of accidental variation in individual examples. The author had referred to lamps which gave less than the nominal candle power at first as being higher in the list. The result was to be expected, as they were marked for less voltage, and naturally lasted longer. He thought the method suggested by Mr. Preece of testing glow lamps by running up the pressure quickly, was well devised for finding what would be the life of the lamp at normal pressure. The plan was convenient, and the results the author had given were of value. Mr. Preece had quoted figures in regard to cost, the lowest value being 0.030 cent per candle power per hour with the Board of Trade unit at 6 cents. Even this was higher than the corresponding cost of gas burnt in an Argand burner, and was far dearer than gas when used in conjunction with the Welsbach mantle. It was to be noted that the whole of the results given were below 100, as compared with the Edison-Swan standard. There was a lamp to which Mr. Preece had not referred, but with which he, the speaker, had lately been experimenting with very promising results. The filament was made from a carbide of silicon. From the tests he had made he felt convinced that Mr. Preece would have exceeded the 100 per cent. standard if he

had included this lamp in his inquiry. It would be interesting if an explanation could be given of the reason for the candle power going up in the Edison-Swan lamp whilst the pressure remained constant. It had been suggested that the improvement was due to improvement in the vacuum. This was a difficult thing to understand, but he had tested it as well as he could, measuring the vacuum by an induction coil, and he had come to the conclusion that in the lamps in which the light improved the vacuum also improved. At first sight he had, therefore, thought that the explanation which assigned the increased light to better vacuum was correct, but other experiments he had made negatived this, and therefore he concluded change of vacuum did not govern the result. Perhaps, he continued, the explanation would be found in the fact that the filaments were not properly formed, and, for a time, improved by use.

Professor Fleming pointed out that Mr. Preece in his specification referred to the standard candle. Now a standard candle in the sperma ceti was a thing that might be very different to the standard candle in an Act of Parliament. It was to be remembered also that photometry was not only a matter of apparatus, but also a matter of observation, a question of instruments and their users. Unfortunately we were not able to follow Dr. Fleming throughout. This we regret as he spoke at considerable length, and his remarks would carry weight. We understood him to say, among other things, that he had abandoned all forms of secondary standards of ordinary kinds, that a final definition of absolute standards was required, and that Mr. Preece's specification should be further discussed and considered before being adopted.

Mr. Swan, who rose at the invitation of the President, pointed to the difficulty of criticising a paper, such as that just read, on the spur of the moment. He considered that valuable information might be obtained from the short test described, for if the voltage were raised steadily but quickly, and the filament were not damaged, it would indicate that the lamp belonged to a long lived family. Testing in the ordinary way was a long and expensive matter. The efficiency of a lamp depended upon the uniformity of pressure, a condition not always present in public supply of electric lighting. Mr. Preece had said that when lamps were not properly marked in regard to candle power, they would deteriorate. Some lamps lost lighting power more quickly than others, but it was evident that if, through being wrongly marked, they were worked at a higher pressure than they were designed for, they would wear out more rapidly.

General Webber suggested that in addition to the candle power and voltage being marked on lamps, makers should also put on the normal watts at which they should be worked.

Mr. Preece, in reply, said that he had not experimented with alternating current, the only current at the Post Office being of a continuous nature. Others had, however, made investigations in this direction, and the results went to show that there was no difference whether alternating or continuous currents were used. It had been pointed out that the cost of the electric light was greater than gas. He must allow that gas was cheaper per hour, but in electric light the facility with which it was turned on and off was sufficient to counterbalance the extra cost per hour. Gas was flaring away often whether wanted or not, but the electric light was always switched off when done with. The cost then might be considered equal, though his experience had been that electricity was the cheaper. On the subject of cost, however, there was much to be hoped for the future. In Liverpool the cost of the Board of Trade unit was 9 cents. If corporations would run their tramways by electricity, so as to bring down the ratio of working expenses, the cost of electric lighting might be reduced to very much below that of gas at even the light per hour standard. If the load could be kept constant, we understood Mr. Preece to say, electricity might be reduced to ½ cent per unit, which certainly seems remarkably low. Perhaps Mr. Preece is a little sanguine—an excellent fault in a pioneer; but in winter, we may point out, the heaviest loads on tramcars would be largely coincident with the fullest demand for light, and a station must be up to its maximum work, allowing, of course, for storage. A larger demand immensely decreases cost of most things, which is especially true of electricity.

West Virginia Coke Production.

[By Mr. Joseph D. Weeks, in his report to the United States Geological Survey.]

But little coal coked in West Virginia is made from washed coal, most of the washing being done in the Northern or Upper Monongahela district. About 10 per cent. of the coal made into coke in this State in 1895 was washed coal.

Pocahontas Flat Top District.—This is one of the most important coking kistricts of the country and shares with the Connellsville in producing a typical blast furnace coke. Indeed, it is chemically a better fuel than the Connellsville, being lower in ash. By some iron masters it is also regarded as a blast furnace fuel physically the equal of the Connellsville. The statistics of the manufacture of coke in the Flat Top district, for the years 1886 to 1895, are as follows:

Year.	Ovens.	Coal Used. Short Tons.	Coke Produced Short Tons.	Value of Coke At Ovens. Per Ton.	Yield of Coal in Coke. Per Cent.
1886....	10	1,075	658	$2.00	61.2
1887....	348	76,274	51,071	1.97	67.
1888 ...	882	164,818	103,947	1.77	63.
1889....	1,433	387,533	240,386	1.69	64.
1890....	1,584	566,118	325,576	1.75	57.5
1991....	1,889	537,847	312,421	1.70	58.
1892....	2,848	595,734	353,696	1.69	59.3
1893....	4,349	746,051	451,503	1.58	60.5
1894....	4,648	1,229,136	746,762	1.325	60.7
1895....	4,648	858,913	524,252	1.25	61.

New River District.—This district includes the ovens along the Chesapeake and Ohio Railroad, from Quinnimont to Nuttallburg. The coal makes an excellent coke and is in great demend, its market being chiefly east of the mountains. The statistics of the manufacture of coke in the New River district, from 1880 to 1895, are as follows:

Year.	Ovens.	Coal Used. Short Tons.	Coke Produced Short Tons.	Value of Coke At Ovens. Per Ton.	Yield of Coal in Coke. Per Cent.
1880....	468	159,032	98,427	$2.14	62.
1881....	499	219,446	136,423	2.45	62.
1882....	518	233,361	148,373	2.38	64.
1883....	546	264,171	167,795	2.29	64.
1884....	547	219,839	135,335	2.03	62.
1885....	519	244,769	156,007	2.08	63.75
1886....	513	203,621	127,006	2.22	62.
1887 ...	518	253,373	159,836	2.51	63.
1888 ...	743	334 695	199,831	1.95	60.
1889 ...	773	268,185	157,186	2.23	58.6
1890....	773	277,458	174,295	2.17	63.
1891....	787	309,073	193,711	2.20	63.
1892....	965	315,511	196,359	2.19	62.
1893....	947	281,600	178,049	2.00	63.
1894....	1,089	222,900	140,842	1.74	63.2
1895....	978	385,899	244,815	1.65	63.4

From the above table it will be seen that the production in 1895 was the largest in its history. It increased from 140,842 tons in 1894 to 244,815 tons in 1895. It is probable that this large production is in a measure due to the demand for coke following the strike in the Flat Top region.

Kanawha District.—The production of coke in the Kanawha district in 1895, like the production in the New River district, with which it is connected, was the largest in its history, the increase being from 104,160 tons in 1894 to 164,729 tons in 1895. This increase was also no doubt due to the strike in the Flat Top region.

The statistics of the manufacture of coke in the Kanawha district from 1880 to 1895 are as follows:

Year.	Ovens.	Coal Used. Short Tons.	Coke Produced Short Tons.	Value of Coke At Ovens. Per Ton.	Yield of Coal in Coke. Per Cent.
1880. ..	18	6,789	4,300	$2.30	63.3
1881....	18	11,516	6,900	2.45	60.
1882....	*138	40,782	26,170	2.40	64.
1883....	*147	58,735	37,970	2.32	64.6
1884 ...	*177	60,281	39,000	1.95	64.6
1885....	†181	65,348	37,551	1.68	57.
1886 ...	302	89,410	54,329	2.17	60.7
1887....	548	153,784	96,721	2.08	63.
1888....	572	141,641	84,052	1.75	59.
1889....	474	109,466	63,678	1.84	58.
1890....	474	182,340	104,076	1.89	57.
1891....	474	241,427	134,715	2.05	56.
1892....	506	242,627	140,641	2.02	58.
1893....	506	215,108	122,241	1.94	56.8
1894....	506	176,746	104,160	1.74	58.9
1895....	506	267,520	164,729	1.64	61.6

*Eighty of these ovens are Coppee, the balance beehive.
†Sixty of these ovens are Coppee, the balance beehive.

Upper Mononguhela District.—The Upper Monongahela district includes the ovens in the group of counties lying along the line of the Baltimore and Ohio Railroad, near the headwaters of the Monongahela

river—Preston, Taylor, Harrison and Marion counties. This is becoming an important coking district, and though the coke is made largely from washed slack it is a good fuel and finds a place in the markets of the country.

The statistics of the production of coke in the Upper Monongahela district of West Virginia, from 1880 to 1895, are as follows:

Year.	Ovens.	Coal Used. Short Tons.	Coke Produced Short Tons.	Value of Coke At Ovens. Per Ton.	Yield of Coal in Coke. Per Cent.
1880....	145	64,937	36,028	$1.91	55.
1881....	172	73,863	43,803	1.78	59.
1882....	222	92,510	55,855	1 88	60.
1883....	269	88,253	51,754	1.76	59.
1884....	281	78,468	49,139	1.52	63.
1885....	278	105,416	67,013	1.45	63.5
1886....	275	131,896	82,165	1.38	62.3
1887....	646	211,330	132,192	2.03	62.5
1888....	567	213,377	138,097	1.27	64.7
1889....	674	210,083	128,685	1.33	62.5
1890....	1,051	276,367	167,459	1.56	60.
1891....	1,081	517,615	291,605	1.58	56.
1892....	1,129	441,266	265,363	1.47	60.1
1893....	1,158	379,506	225,676	1.31	60.
1894....	1,221	280,748	158,623	1.13	56.5
1895....	1,260	392,297	240,657	1.10	61.3

Upper Potomac District.—In the Upper Potomac district are included the ovens along the line of the West Virginia Central and Pittsburgh Railway, running south from near Cumberland, Md.

Statistics of the production of coke in the Upper Potomac district of West Virginia are as follows.

Year.	Ovens.	Coal Used. Short Tons.	Coke Produced Short Tons.	Value of Coke At Ovens. Per Ton.	Yield of Coal in Coke. Per Cent.
1887....	20	3,565	2,211	$2.00	62.
1888....	28	9,176	5,835	1.50	64.
1889....	84	26,105	17,945	1.58	69.
1890....	178	94,983	61,971	1.91	65.
1891....	390	111,014	76,599	1.75	69.
1892....	395	114,045	78,691	1.54	69.
1893 ...	394	123,492	84,607	1.36	68.5
1894....	394	66,598	43,546	1.00	65.4
1895....	442	183,187	110,753	1.14	60.5

The increase in production in this district in 1895 over that of 1894 is a notable one, the production in 1895 being 110,753 tons and in 1894 but 43,546 tons, an increase of 67,207 tons, or nearly 155 per cent. While it is probable that the strike in the Flat Top region is in a measure responsible for this great increase of production, there can be no doubt that this coking district is assuming greater importance in the markets of the country.

Blasting in Collieries.

[A paper read by PROF. M. C. IHLSENG before the Pennsylvania Central Mining Institute and the Ohio Institute of Mining Engineers.]

One of our humorists said of powder, with more truth than poetry, that in itself it is perfectly harmless, but it is the fire that makes it dangerous. This thought has been pressed home during the past few months while engaged in analyzing our own mine inspectors' reports and comparing the results with those of foreign countries. In fuse, cap, squib, lamp and pipe are the elements of danger. Firedamp, coal dust and air are the ever present fuel for the flame, and may be passive or active, according to the attendant circumstances which we do not fully understand. Imperfections in manufacturing, carelessness in handling and over-confidence in its use are the conditions which finally result in an explosion in which neither life nor property is spared by the devastating flame. The concomitant circumstances inducing or aggravating colliery explosions seem to elude our most vigorous search. Some of the causes are easily traced and are well known. The origin of some of the explosions is not thoroughly conceded. Many of the disasters occur under circumstances apparently mysterious and where much firedamp did not likely exist. Some causes are still unaccountable; they baffle our closest investigations. Some seem remediable, yet they resist our greatest defensive skill, while of others their effects may be mitigated, if not actually controlled. We may dilute the inflammable gases by a copious, well directed air supply, and render them innocuous. We may seclude the illuminating flames of our safety lamp. We may sprinkle and precipitate the coal dust, and we may regulate the manner and the time of blasting. The mine inspectors, operators and employees may, and do, co-operate to give effect to the regulations for the safety of the mine and the health of the employees, and yet during last year 240 lives were sacrificed in hundreds of accidents from explosions of gas. This aggregate is much smaller than has been witnessed in seven years, and compared to the total number of fatalities is only a trifle smaller than formerly. Indeed, this comparative figure, as a matter of fact, will continue to increase rather than decrease, because with the growing intelligence and care of our miners, accidents from falls and cars do perceptibly diminish each year, and because with the increasing depth and consequent dryness of mine is added that dreaded element of danger which has the power of propagating flame and of imparting explosive character to a slight admixture of firedamp with air.

The explosive material may consist of gas, of traces of firedamp and dust, or of mixtures of air and dust alone, but whatever they be, there will be no explosion, no ruinous hurricane, unless and until the necessary and sufficient element, fire, be brought into contact with them. The source of the combustibles may be unknown, their composition may vary and the most patient search fail to reveal the reason for their violent behavior, but we do know how disastrous are the results when heated to a temperature above their point of ignition.

Firedamp continually exudes from the coal and white damp from goaf or gob to threaten us; of the former, from one district, there were carried out by the ventilating air currents 39,700 tons per year, and of the latter gas, an average of the numerous analyses of the upcast showed 650 tons of the poisonous inflammable carbonic oxide to have been swept out of the mine atmosphere. These combined nearly equaled in aggregate calorific power the total volume of coal produced by the same colliery during the same time. But these are not our sole enemy; for while they create a condition for explosion, there is always a possibility of reducing the extreme danger by a plentiful supply of air and there is a probability of its immediate detection upon expulsion into the mine, its presence is not always necessary for the propagation of flame with explosive effects, if dry coal dust is afloat in the air. For the latter, in its highly comminuted and porous state, has the power of condensing upon its surface and retaining there, and also of absorbing, oxygen from the ventilating current. A room full of such dust is actually a huge explosive cartridge of solid and gaseous combustible matter which needs but one element for its decomposition. This condition prevails in our bituminous mines. They are not regarded as gassy, and yet explosions therein involve greater areas than do those in anthracite mines which rank as the most gaseous in the world. In the latter there is comparatively little dust and a very small amount of absorbed gases to propagate the explosion. Explosions in anthracite mines are therefore comparatively local in their results. No coal mine is free from gas or coal dust and its safety depends upon the elimination of every source of flame or fire from all its operations. Illumination we must have and that by flame, even than it is not better than the Davy or the Clanny, which gives us but one-fourth of a candle power: and this is the only form of flame permissible underground. Grant that it may be supplanted by some better illuminant for our roof. Though other sources of flame yet exist in our underground workings, all are accidental except that developed at the time of the ignition of the blasting powder employed to release the coal from its place. It is true that the amount annually employed is gradually decreasing with an increased skill and the employment of underholing machines, nevertheless we still use throughout our State 2,000 tons of black powder, in the combustion of which we liberate into the mine gas, flame and sparks enough to account for many of the seemingly mysterious explosions. The importance of a closer attention to this branch of operations cannot be over-estimated. An improvement in their grade and the exercise of greater care in their use I am sure you will agree with me will procure for us a healthier and a safer condition of mine, for there will be eliminated some of the prevailing dangerous conditions with which we are fully cognizant, but with which by our present means we seem to be unable to cope.

That black powder is totally unfit for use in gaseous collieries, we must admit, also that the time has come when we should have the courage of our convictions and restrict its use. Long have we been familiar with the accidents from misfired shots, from premature explosions and from blown-out shots. Long have we recognized its deficiencies and continued to use it without protest, and probably the most of us have witnessed the degeneration of some grades of these disruptive agents. Why continue to accept the present order of things? Let us fulfill our mission as engineers and render still more safe the lives of those who are entrusted to our care, and the property of our employers.

It was once my misfortune to have some experience in another field

with one of the inferior grades of black powder containing, as a result of the active trade competition, an excess of the cheap constituents which resulted in the development, upon ignition, of an excessive amount of carbonic oxide. One pound of such powder projected into the mine atmosphere four ounces of this gas sufficient to vitiate a room 20 feet wide, 5 feet high, and for a distance back from the face of 3 feet, to a poisonous degree. A human being could not live in this atmosphere. And this product, itself combustible, is in a nascent state and will ignite at a comparatively low temperature. When the heat of combustion reaches the temperature of ignition of this gas, it is exploded with the emission of a flame which becomes the nucleus of the auxiliary explosion which is so much dreaded, because, while the first raises a cloud of dust, the second converts the workings into a seething mass of flame. This expands the later products of combustion and forms a new explosive zone which traverses great lengths of gangways and into vast areas of workings. This arises from the incomplete combustion of the ingredients of the blasting agents. They are either not in proper proportions or are not in mechanical intimacy. The combustible and oxidizing bodies must be perfectly resolved into their respective molecules for instantaneous combination into gaseous forms, and there must be sufficient available oxygen to burn the combustibles. These deficiencies it remains for the manufacturer to supply. In this regard it must be said that the unglazed powders are undoubtedly an improvement upon those whose grains are glazed, for they burn more quickly with the evolution of less noxious products. But even these are better and more powerfully fired by the aid of a detonator than by the treacherous sputtering time fuse. A strong detonator with a sufficient fulminate and an electric machine for firing it are the *sine qua non* of any safe explosive. If, in addition to this, the powders be well rammed and tamped with a hard non-carbonaceous material, the gases will be more strongly confined and more of the evolved heat will be converted to mechanical disruptive energy. By this means both the efficiency and safety would be increased to a comparative degree. Even with these improvements in our use of powders there remains the liability to blown-out shots or the deleterious effects of the products of their combustion which have so toxic an effect upon the system.

Explosives which are capable of complete detonation, as are the nitroglycerine compounds, are safer for mining purposes, though more shattering in their effects. They emit little, if any, flame and evolve no combustible gases. Nitroglycerine has a sufficiency of oxygen in its composition for completely burning the combustible elements to carbonic acid, and at the risk of arousing criticism, I venture to commend the use of dynamite in proper charges as productive of good results, even in so brittle a material as our coals. The deep grooves and the deeper holes which would be necessary would militate against the extended employment of dynamite in rooms as well as in rock work. It is perfectly harmless, safe to handle, easy to transport, so long as no liquid nitroglycerine exudes, and so long as it has not suffered deterioration by being stored underground or in a damp place. The risks of explosion are lessened, but not eliminated by its use, and it is a gratification to notice the increasing use of dynamite in the gaseous mines of this State. I predict that the near future will witness its entire substitution for black powder.

In several countries of Europe the use of black powder has been prohibited in coal mines, and in more has its employment been restricted to districts which are regarded as absolutely safe. The number of mines embraced in the latter category is rapidly diminishing with the recognition by the operators of the amount of energy wasted in incomplete combustion of their explosives and the discovery by the officials of the presence of dust and gas in hitherto unsuspected places. Over 60,000,000 tons of coal were mined last year without the use of black powder, and, indeed, wherever it is prohibited almost the entire product is removed by high explosives of a class known as the "flameless explosives," and called by some the Sprengel explosives, after the inventor, Dr. A. Sprengel.

Here we have a group of mechanical mixtures of two explosive compounds properly proportioned for the necessary chemical reactions, and possessing four desirable qualities of a good powder, being solid, permanent in character, exploded by a detonator, and entirely convertible into gas. Whatever the names by which these flameless powders are known, they contemplate a mixture of a hydrocarbon combustible in a condition favorable for a rapid decomposition and an easily decomposable oxidizer that will not only develop the full energy of the explosive with a freedom from fumes of any sort other than the ordinary products of combustion, but will also be quite free from the projection of flame from the drill hole. Though there may be a variety of nitrated organic substances which will supply the fuel, and di-nitro benzol is the basis of some of them, in every case nitrate of ammonia furnishes the oxygen for supporting combustion.

The element of safety in the use of these explosives lies in the amount of heat necessary for the decomposition of the ammonia nitrate, and in the chemical reactions, which are set up at the time of ignition, serving thus to reduce the temperature of the gaseous products of combustion, and finally to prevent the formation of flame. It is not necessary to do aught here but to name the best known compounds belonging to this group, for you are familiar with their composition and behavior. Ammonite, bellite, roburite and securite possess the requisites of a safe blasting agent. Safety is of greater importance to us than are its ballistic effects, and in this class of explosives we have the nearest approach to something safe for mining purposes.

This class of explosives has been examined by numerous committees and commissions, has been the subject of scientific investigations, has strong official indorsement from those who were using it in Austria, Belgium, France and Germany, and it seems a fitting time for American miners to take hold of the subject for the betterment of our mines. The powder is safe to handle, neither element will ignite by heat, flame or electricity. Compare that with the dangers coming from the careless use of black powder. Observe the possibilities of reducing the accident record from premature blasts. It is safe and rapid in action and requires a specially powerful detonator for its concussion to sufficiently divide the elements into their molecular state for quick decomposition into expansive gases. Observe how this will eliminate from our list accidents from picking out miss-fires. Again, the products of combustion are non-inflammable and non-poisonous, with a temperature of explosion as low as is compatible with rapidity of action. What a blessed relief its introduction would afford us.

True, it is not strictly flameless, but that should not debar it from favor here. That it is less liable to flame than is powder, is true, as also that the constituent, common to all members of the Sprengel class —the nitrated ammonia—is deliquescent, and in absorbing moisture from the air deteriorates in quality. This may be remedied by dipping cartridges in nitrated resin or by keeping the two combustibles separate until required for use when they may be mixed in proper proportions and loaded. In this regard the safety explosives are all alike, as also is the oxidizing element. So that when comparing the several members of the group with a view to selection of the best, that one will be advised which has a hydrocarbon in the most decomposable form. It has been said by an eminent authority that "the Sprengel explosives are as far ahead of black powder as the Davy lamp surpasses the naked light." It is only a question of a short time when they will receive universal adoption. Until we have taken every possible precaution we are not absolved from the responsibility of accidents and explosions arising from the various sources of fire. At present we fall short of fulfilling the requirements which recent valued reports of eminent committees have shown to be necessary for safety. We must discard the present explosives not possessing self-extinguishable elements, and substitute therefor agents which are free from the dangers specially attending the use of those explosives, and this can be done without the sacrifice of efficiency as may now be readily understood.

I concede that there do exist places in a mine the atmosphere of which is positively unsafe for any explosive. Then the fault lies with the condition in which the rooms are and if there is not a possibility of effecting a change of method of work from pillar and room to long-wall, slacked lime might serve, or a vigorous watering might be resorted to, though the latter to my mind has proven a delusion and a snare, so far as any evidence of beneficial results is concerned. During periods of rapid atmospheric depression, blasting operations should be conducted with the greatest caution, if not actually suspended. Such a suspension is practicable if the shooting is entrusted to a skilled workman. The use of central fire cartridge and a magneto-electric battery with safety explosives would virtually remove the item of explosion accidents from the mine inspector's classification by leaving only one source of flame to endanger the mine and miners. As tending to the same end, I venture to commend the installation of coal cutting machines not only on the score of the increased economy of labor and power, but on the score of specializing the remaining operations involved in the removal of coal—one man having charge of the blasting operations only.

These may seem drastic measures, and objections will doubtless be set up against them, but history repeats herself and the opposition will succumb to the inevitable. What has been accomplished in the installation of nitroglycerine for rock work will be effected with nitroglycerine and Sprengel explosives for coal. A sound, practical, scientific progress will have been recorded when more active measures are taken

also to regulate the manufacture and use of all kinds and grades of permissible explosives. We deceive ourselves when we place entire reliance upon a copious supply of ventilating air with its consequent high velocity, for the most markedly conspicuous feature of all extensive catastrophes of this nature is the fact that roads which are not haulage ways, and through which the air courses at only moderate velocities, are exempt from the effects of explosion.

If we relax our vigilance and fail to remove every possible source of flame we lull our fears to rest and are apt to pay the price later. "Eternal vigilance is the price of safety" has long been the motto of the mining engineer. There is no industry in which all engaged have so actual a mutual interest as in mining, and none in which officials, employees and owners more co-operate, appreciating that a safe mine is a healthy mine and a secure investment. Mining of to-day is hardly more hazardous an occupation than railroading. If the accidents are localized by employing a restrictive energy at the point of origin of the fire it will become a comparatively safe pursuit.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE proprietors of the Titusville (Pa.) Gas Company have ordered a reduction in the selling rate that is equivalent to a concession of 25 cents per 1,000 cubic feet. Heretofore the rate has been $1.25 per 1,000 cubic feet, with 5 per cent. off for prompt payment; hereafter it will be $1, with 5 per cent. off. The Company also agrees to s'and one-half the expense of renewing mantles and chimneys on Welsbach lamps to which illuminating gas (artificial) is supplied.

A REPRESENTATIVE of a Chester (Pa.) newspaper recently visited the offices and showrooms of the Delaware County Gas Company, of Chester, and this is what he had to say about the outfit after looking it over carefully: "No brighter place is to be found in the city during the evening than the offices and showrooms of the Delaware County Gas Company, at 103 West Third street. The Company is having its opening this week [first week in October] for the purpose of exhibiting the latest patterns in gas stoves, and to show to the people the superiority of the Welsbach burner. The main showroom is brilliantly lighted by about 40 Welsbach lights, with various colored shades, their soft, white flame throwing mellow light about the room and upon the numerous floral decorations. The desirability of gas stoves is too well known to need any arguments in their favor. The Welsbach light, in addition to giving a better light than the incandescent electric light, is much cheaper. The reporter was shown some receipted bills, which had been paid by one of the prominent merchants of Chester. The bills for electric lighting for one running year amounted to $245.52, while the gas bill for the same amount of light and time, the Welsbach burner being used, was but $97.86, a clear saving of $147.66 in one year. The display is well worth a visit from the business men and householders of Chester." The display above referred to was arranged mainly by Mr. J. M. Callanan, the Manager of the Company's fuel department.

THE Brunswick (Ga.) Light and Fuel Company was a sufferer from the wind and rain storm that swept certain sections of the South on the last day of September. We are glad to say, however, that the damage to its property (originally put at $20,000) was not anything near to the sum reported.

LOCAL advices are to the effect that the Winona (Minn.) Street Railway and Light Co. proposes to construct a gas works of the water gas type. It is further said that construction work will not be proceeded with until next spring; and it is our opinion that no commencement on it will be made even then.

SOME days ago 225 shares of stock in the Lincoln (Neb.) Gas Company were sold at auction for $6,000.

CHAUNCEY MANN, for some time a trusted foreman in the employ of the New Haven (Conn.) Gas Company, died at his home in that city on the 3d inst. He was in his 51st year.

THE St. Paul (Minn.) *Pioneer Press* says that articles incorporating the American Acetylene Company, of Minnesota, have been filed with the Secretary of State. The Company will have its principal offices in Minneapolis, and its capital stock is returned at $50,000. The incorporators are Messrs. M. J. Ham, A. J. Murdock, O. E. Mille and F. D. Dibble, all of Minneapolis.

THE Lamps and Gas Commission of this city met some days ago to consider matters connected with the lighting of the streets. Commissioner Collis gave it as his opinion that all the arc lamps in the city should be changed to the type which have been in use on Fifth avenue for some time back, which proposition elicited from Comptroller Fitch the very sensible remark that a lamp suitable for Fifth avenue might not be equally suitable for Cherry street or Mulberry Bend.

THE Common Council, of Lawrence, Mass., have adopted a concurrent resolution to the effect that the public lighting of that city shall be performed by the Lawrence Gas Company for a period of not less than five years.

MR. THOMAS H. HINTZE has resigned the Superintendency of the Chelsea (Mass.) Gas Light Company to assume the engineering management of the Malden and Melrose (Mass.) Company. Some years ago Mr. Hintze was Assistant Superintendent of the Malden Company.

THE output of gas by the New Bedford (Mass.) Gas and Edison Light Company, for the twelvemonth ended June 30, 1896, amounted to 52,199,507 cubic feet. The Company has 2,798 consumers' meters in service.

THE Lamp Department of New Haven, Conn., estimates that the cost of public lighting in that city for the year will amount to $83,148, over one-half of which ($45,000) is to be charged to electric lighting.

THE plant of the Pintsch Compressing Company, in Pittsburgh, Pa., is to be located on Second avenue, near Tenth street.

THE United Gas Improvement Company has secured the contract for enlarging the generating capacity of the Poughkeepsie (N. Y.) Gas Company. Under the agreement the contractor is to install one of its standard, double superheater Lowe water gas sets, of a capacity of upwards of 350,000 cubic feet per day.

THE following letter should be taken as a supplement to our item of last week respecting the experience of the Staunton (Va.) gas works in the recent severe storm in the South:

OFFICE OF SUPERINTENDENT OF GAS WORKS,
STAUNTON, VA., Oct. 12th, 1896.

To the Editor AMERICAN GAS LIGHT JOURNAL: No doubt you have read the newspaper reports of the flood which occurred here September 29th. The water was up to the bottom of top retorts in one bench of fives, and 2½ feet over the top of the reservoir of our largest holder, which was full of gas at the time. The bottom of holder was lifted above the top of reservoir, and the current moved it out of place about 2 feet. We were trying to get it back in place as the water was falling, and the gas caught fire, from the torches which we were using as lights, as soon as the water lowered to the level that permitted the gas to escape under the side that rested on the wall of the reservoir. The gas continued to burn until the holder was exhausted. This was what the newspapers reported was an explosion. We were able to recommence the supply of gas to the town on the 3d inst. It was the first time in 30-odd years that the town was without gas. Our loss will be between $300 and $400. Yours respectfully, J. H. WOODSON, Supt.

THE salaries of the Trustees of the city gas works, of Hamilton, O., have been increased from $100 to $200 per annum.

THE Kansas City *Times* says that among the most tasty and elaborate individual illuminations for "Karnival Week" were those of the Kansas City Gas Company, at Tenth and Walnut streets. Two arches of 25 feet each extended along the Walnut street front, and two similar arches were on the Tenth street side, the two being connected by an immense double arch over 50 feet in length. Five similar arches then crossed the sidewalk at intervals, connecting the outer lines with the building. Every arch was a series of jets supporting glass globes alternating the "K. K. K." colors, red, green and yellow. At either extremity of the several arches were columns supporting clusters of 30 globes each, of the three different colors, the whole presenting the appearance of a continuous arch of tri-colored lights. The design was the work of Mr. Harry B. Holmes, an employee of the Company, and it called for the use of 1,000 gas tips and 335 globes of the different colors.

MR. WALTER MATTHIES has been appointed Secretary of the Petaluma (Cal.) Gas Light Company.

MR. W. W. GILLESPIE has accepted the position of Agent in San Francisco for the Welsbach Light Company. Mr. Gillespie was Secretary and Manager of the San Jose (Cal.) Light and Power Company.

THE residents of Wenonah, a suburb of Woodbury, N. J., have petitioned the Consumers Gas Company, of Woodbury, to extend its pipes through their territory.

THE Fall River (Mass.) *Globe* says that the improvements and extensions of the Fall River Gas Company's plant are well under way, and before the 1st of January the people of the city will be enjoying $1.25 gas. Since the Company acquired the plant owned by the Manufacturers Gas Company, all the residential portion of the latter's clientage has been supplied with water gas made at the Fall River Company's works on Water street. This portion included all of the Company's customers south of Rodman street. The mills that used the Manufacturers' product are still using it, and will continue to do so until November or December, and possibly until spring. Coal gas is still being manufactured at the Fifth street works, and it is this quality of gas that the mills supplied by the Manufacturers Company are still using. Down at the Fall River works, at the foot of Anawan street, the big plant is being more than doubled in capacity. At the present time there is apparatus up to making about 800,000 cubic feet of water gas per day, and the additions being made will provide 1,000,000 cubic feet. The problem of equalizing the distribution is already being solved. A 12-inch main is being laid in Anawan street, and will be continued through South Main to Borden and to Fifth street, where it will be connected with the two holders acquired from the Manufacturers Company. Eventually the manufacture of coal gas will be discontinued and the mills will be supplied from the Anawan street works through the new main. Within a year it is quite probable that work will be be gun on a large holder to be located on the site of the Fifth street works. It will be large enough to contain the entire output of the plant for 24 hours. It was hoped that the preliminary work of consolidation would have gone on rapidly enough to warrant the beginning of the new additions and improvements earlier in the year; but it was delayed from one cause or another, and the delay will in turn cause some annoyance to consumers during the winter. Water gas requires more air than coal gas to insure perfect combustion, and for that reason all the gas stoves and heaters and burner tips used on the Manufacturers connections will have to be readjusted as rapidly as the gasfitters can get around to them. If the work is done by an expert fitter it will prove more satisfactory than if it is tinkered with by a green hand. The amount of gas now used in the city is greater by one-third than a year ago and far greater than ever before in the city's history, so the use of arc and incandescent electric lights has not had the effect of decreasing the amount of gas used. Gas stoves, gas heaters, the improved Welsbach light and the increasing demand for light in the mills are, in some measure, the causes for the great increase in the demand for gas. As stated, the price will be lowered just as soon as the new apparatus is ready for use, and Fall River will then be obtaining gas as cheap as is the case in New York City.

THE annual general meeting of the Consumers Gas Company, of Toronto, Canada, will be held in the Company's office, No. 19 Toronto street, at noon of the 26th inst.

THE Town Council, of Warren, R. I., has under consideration a petition from the Bristol County Gas and Electric Company, under which the petitioner asks for the exclusive right and franchise, for a period of 25 years, to erect and maintain poles, wires and pipes in the streets for the purpose of producing, selling and distributing electricity and gas, in accordance with the provisions of Chapter 77 of the general laws, which permits Councils to grant exclusive franchises for this object for a period not exceeding 25 years, upon payment of a tax not exceeding 3 per cent. of the gross earnings of the Company. The Company offers to furnish necessary arc and incandescent lights, the former of 1,200-candle power and the latter of 25-candle power, to burn either all night or until half hour after midnight or otherwise as desired, at $70 per night each for the ares to burn till half hour after midnight, and $140 per year for those to burn all night. The price named for incandescents is $17.50 for the 12:30 o'clock service, or $35 for the all-night service. The offer of the Company also provides for the addition of lights during the continuance of the franchise, and agrees to an adjustment of prices every five years by arbitration.

MAYOR MONIHAN, of Phœnix, Arizona, insists that the franchise, granted in March, 1892, to the Gardiner syndicate, for the right to maintain general systems of piping through and over the streets of the city for the distribution of gas and water, shall be declared void. The franchise provided that the syndicate should be ready to supply gas or water, or both, within two years from the date thereof, but no work of the sort stipulated has been performed up to the present time.

MESSRS. J. H. GAUTIER & CO., of Jersey City, are reconstructing the benchwork at the gas works maintained by the State of New Jersey at the Morris Plains asylum. The agreement calls for the replacing of the old style plan of firing with Flemming furnaces. The proprietors of the gas plant which supplies the towns of Saco and Biddeford, Maine, have also ordered two benches of 6's to be fired under the Flemming plan. The new retort house of the Lebanon (Pa.) works is equipped with Flemming benches; and the Perth Amboy (N. J.) Company has changed to the Flemming system.

THE proprietors of the Western Gas Construction Company, of Fort Wayne, Ind., inform us that this year proved to be one of the busiest years in their history. Despite the general depression of trade the shops have been run never less than full time, and for the last four months overtime has been the rule rather than the exception. The Company's season opened with the securing of a contract from the Milwaukee (Wis.) Company for two 1,000,000 cu. ft. sets of the Construction Company's double superheater improved Lowe water gas apparatus. The operation of the apparatus was so satisfactory on the initial test that the purchasers accepted the complete installation and paid for it before the second set was put in use. The proprietors of the Construction Company assert that the result at Milwaukee amply proves their ability to construct water gas plants up to any capacity. The water gas apparatus installed on the Pacific Coast, at Santa Barbara and Bakersfield, continues to give every satisfaction, for the proprietors of the plants named say they are more than pleased with the results. Low grade California oils (27°), and even California distillates, are handled without the use of steam or other treatment in the carbureter, and the coke and oil used are well within the limits of the guarantees. The smallest apparatus ever built by the Western Gas Construction Company and probably as small as any other in existence, having a superheater only 3 feet outside diameter, was installed for the Pomona (Cal.) Gas and Electric Company, and it has yielded satisfactory results on an output of only 5,000 to 6,000 cu. ft. per day, although the machine is rated to a daily capacity of about 50,000 cu. ft. Other contracts secured by the Company this season were a special setting of double superheater apparatus for the Middletown (N. Y.) Gas and Electric Company, which makes the second apparatus of this type at that point; a double superheater set for Rutherford, N. J.; a second set for Nyack, N. Y.; and a water gas set of the improved single superheater type for Messrs. Wm. Knowlton & Sons, of West Upton, Mass. Also, the reconstruction into double superheater setting of the water gas plant of the Fostoria (O.) Company. Other contracts awarded the Construction Company were: A set of three purifiers, 24 feet by 30 feet by by 5 feet deep, with hydraulic travelling crane, and the new 20-inch valve connection of the Western Company's design, for the Toledo (Ohio) Gas Light and Coke Company—the contract at this point also includes the iron work complete for eight benches of 9's, with wrought iron mains, self-sealing mouthpieces, bridge pipes, iron roofs and windows, floors, foul main, etc.; and iron work for benches at Saginaw, Winona and Rochester, and small sets of purifiers for other points have kept the Company busy. The Laclede Gas Company placed an order with the Western Construction Company for an outfit of its new system of valve connections in the purifying house, which the constructors hope to have in operation before the meeting of the American Gas Light Association. The Laclede Company has also placed an order with the Construction Company for a multitubular condenser rated to a capacity of 2,000,000 cubic feet. The valve trade of the Construction Company is an important feature of its business. The gas engine department of the Company is represented by a very important installation of a 130-brake horse power gas engine, of the Kilmarnock double-acting type, for the Lancaster (Ohio) Traction Company. This engine is driving a street railroad electric generator for 18 hours per day since the 1st of July. It is the first engine of its kind installed in the country, and we will likely illustrate and describe it in a subsequent issue. The tests show a remarkable closeness of regulation under extreme variations of load, and its results have been so satisfactory that the Marietta (O.) Electric Company, after close inspection of the Lancaster example, placed an order for two similar engines for the new electric railway plant at Marietta, and these are now in process of construction. The Standard Oil Company also purchased a 35-horse engine and placed it on very severe work in the Indiana oil fields. The prospects for the sale of these large engines are excellent, and the officers of the Western Gas Construction say they are well pleased over the situation.

THE AMERICAN GAS LIGHT JOURNAL

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MONDAY, OCT. 19, 1896.

Coke versus Coal in Foundry Melting.

At the October meeting of the Foundrymen's Association, held at the Manufacturers' Club, Philadelphia, on the 7th inst., one of the topics discussed was that named in the headline. Mr. Schumann asked whether it was not a fact that coke had been more extensively used in consequence of the inequalities existing in coal rather than the difference in cost. Mr. Outerbridge replied that he did not think so. Mr. Schumann, giving his own experience, said that his Company used coke because they could not get good coal. They once used to mix their charge, using probably a quarter coke, until finally they used nothing but coke, a condition largely due to a lack of good coal. Mr. Devlin believed that one of the chief reasons for using coke was that it was quick melting. He had found it possible to melt in 35 per cent. less time than had been the case where the best coal mined had been used. For that reason alone he used coke. Mr. Whitney reported that his firm used coke for the same reason. They used coal in the bed, but coke in the charges. Mr. Carlton, of the Pratt & Whitney Company, Hartford, Conn., reported he had used coke for several years in part, but never as a general thing entirely. He had found that he could do better with part coal. He did not believe that one had any advantage over the other in producing good castings. He used coal on the bed and on all the intermediate charges. Mr. Schumann said that his Company had burned nothing but coke, both for the bed and all through the charges. One of their cupolas was 18 inches, another 48 inches and another 60 inches diameter, and they made castings running from 100 to the ton to castings of 20 tons each. They had made plates ½-inch thick, 62 inches wide and 17 feet long, and the same cupolas melted the iron for castings weighing 20 tons.

From the 18-inch cupola they melted 4,000 pounds, and it was charged with nothing but coke. With the other cupolas they also used coke exclusively. The efficiency of coke, aside from its theoretical advantages, could not, he thought, be denied when such results were obtained. It was necessary, to run a large plate, to have very hot iron. As he had previously stated, they formerly used coal, and at a time when they had a contract for making wire benches, which, as was well known, were about 18 inches high, 14 inches wide, and were very thin. These benches were made from standard irons, and were cast ahead for the convenience of the machine shop. The coal was of such a nature that the castings could not be touched with the ordinary tools in the machine shop. He thought the fault attributable to the pig iron men, but was afterward convinced that it was due to the coal.

The Market for Gas Securities.

The market for city gas shares is virtually featureless, unless one is willing to accept stagnation as a feature, in which event the market may be considered as nothing but feature. Consolidated opened to-day (Friday) at 144 to 145, and inquiry for it was merely nominal. Equitable, Mutual and Standard are all a trifle higher in respect of the average bid price, while New York and East River common is lower, at 33 to 35.

The Lamps and Gas Committee, of the Board of Aldermen, after quite a struggle to comprehend the full meaning of the applications from two or three companies, desirous of the right to lay pipes through the city's streets for the purpose of distributing fuel gas, have handed in a report. They recommend that the "right" be awarded to the projectors of the Consumers' concern, whose original application was made last May, on the ground that they were the first in the field. The consent of the Board of Aldermen, however, is held by the Corporation Counsel to virtually amount to nothing so far as any valid right to operate a Company under such consent is concerned.

Brooklyn Union is steady, and the Company's fives are in good demand. The feature of the outside market was the break in Bay State, which declined in Boston to 7¼ this morning, on the announcement of the appointment of receivers in Delaware for the Bay State Gas Company. Chicago gas shows no change from the figures of a week ago, and it is cheap at the market. Baltimore Consolidated is steady. The general situation seems to point to higher prices.

Gas Stocks.

Quotations by Cochran & Close, Brokers and Dealers in Gas Stocks.

35 WALL ST., NEW YORK CITY.

OCT. 19.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$35,430,000	100	144	145
Central	500,000	50	150	..
" Scrip	220,000	..	100	.
Equitable	4,000,000	100	194	200
Bonds, 6's	1,000,000	1,000	105	.
" 1st Con. 5's	2,300,000	1,000	114	.
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	220	230
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	.
Northern	150,000	50	79	80½
" Bonds	150,000	1,000	..	98
New York and East River	5,000,000	100	33	35
Preferred	2,000,000	100	60	70
Bonds 1st 5's	3,500,000	1,000	100	101½
" 1st Con. 5's	1,500,000	..	89	90½
Richmond Co., S. I.	348,650	50	50	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	81	83
Preferred	5,000,000	100	106	108
Bonds, 1st Mortgage, 5's	1,500,000	1,000	107	111
Yonkers	299,650	50	130	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	88	92
" " Bonds (5's)	15 000,000	1,000	105	105½
Bay State	5,000,000	50	8¼	8½
" Income Bonds	2,000,000	1,000	27	30
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	76	73
2d " " "	3,000,000	1,000	60	65
Buffalo Mutual	750,000	100	125	..
" Bonds	200,000	1,000	95	100
Central, San Francisco	2,000,000	..	95	..
Chicago Gas Co.	25,000,000	100	59¼	60
Chicago Gas Lt. & Coke Co. Guaranteed Gold Bonds.	7,650,000	1,000	94	94¼
Columbus	1,069,000	..	..	65
1st Mortgage	1,085,000	..	..	96
Consumers, Jersey City	2,000,000	100	60	75
" Bonds	600,000	1,000	97	101
Cincinnati G. & C. Co.	7,000,000	100	196¾	198¼
Consumers, Toronto	1,600,000	50	184½	187
Capital, Sacramento	500,000	50	..	30
Bonds (6's)	150,000	1,000	..	..
Consolidated, Baltimore	1,000,000	100	..	62¾
Mortgage, 6's	3,600,000	..	107	107½
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490,000	..	..	..
Detroit	4,000,000	..	32	33
" Con. Bonds	4,312,000	..	..	82
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	78	83
" Bonds	2,000,000	..	82	85
Hartford	750,000	25	..	14
Indianapolis	2,000,000	..	120	130
" Bonds, 6's	2,650,000	..	99½	101½
Jersey City	750,000	20	180	..
Lafayette Gas Co., Ind.	1,000,000	100	80	85
Bonds	1,000,000	1,000	80	85
Louisville	2,570,000	50	..	..
Laclede, St. Louis	7,500,000	100	24½	25
Preferred	2,500,000	100	78	80
Bonds	9,034,400	1,000	92	92½
Little Falls, N. Y.	50,000	100	..	100
Bonds	25,000	..	..	100
Montreal, Canada	2,000,000	100	200	.
Newark, N. J., Gas Co.	1,000,000	..	93	98
Bonds, 6's	4,000,000	.	123	..
New Haven	1,000,000	25	225	..
Oakland, Cal.	2,000,000	..	52	53¼
" Bonds	750,000	..	..	..
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,00	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	..	175
Paterson, N. J.	.....	25	99	102
Rochester Gas & Elec. Co.	2,150,000	50	..	..
Preferred	2,150,000	50	88	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10.000,000	100	93½	93¾
St. Paul Gas Light Co.	1,500,000	100	67½	70
1st Mortgage, 6's	650,000	..	84	87
Extension, 6's	600,000	..	.	..
General Mortgage, 5's	2,400,000	.	88	90
Syracuse, N. Y.	500.000	25	..	..
Washington, D. C.	2,000,000	20	250	
Western, Milwaukee	4,000,000	100	60	63
Bonds, 5's	3,556,000	.	88	91
Wilmington, Del.	500,000	50	180	182

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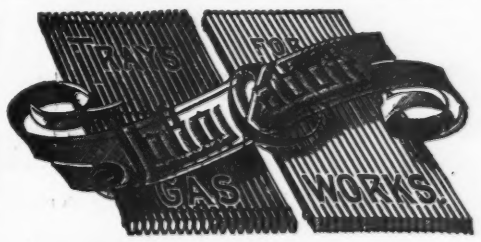

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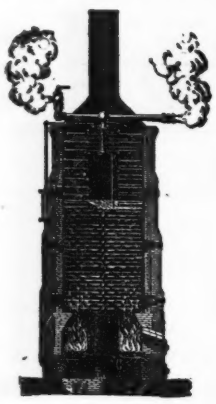

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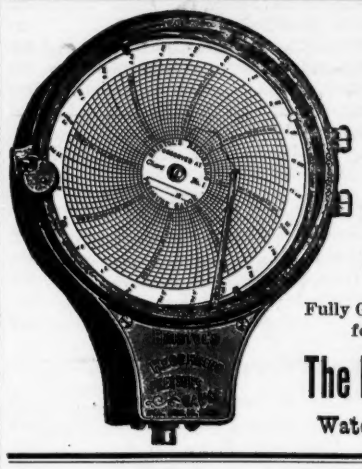

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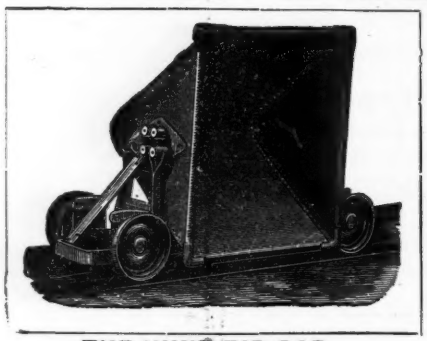

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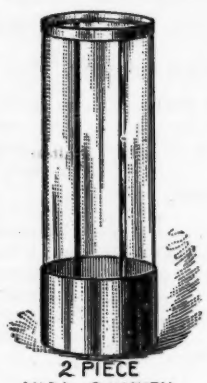

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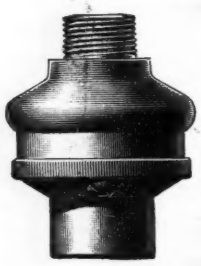

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PROSPECTUS.

THE object of the **Gas Exposition** is to bring together a collection of gas apparatus and appliances of every description, for the two-fold purpose of affording the general public and the gas engineer an opportunity to study the developments that have taken place in the gas industry during recent years. In submitting the plan of the Exposition to those who may feel an interest in the project, the management would call the attention of manufacturers of supplies of every description, entering into the manufacture of gas, to the great benefits which similar affairs have conferred on the industries of Great Britain, Germany and France, in which countries the exhibitions of gas appliances are held with recurring frequency. The creation of a healthy public sentiment in favor of gas is one of the first aims of large numbers of foreign gas companies.

MADISON SQUARE GARDEN.

In the selection of New York for the inauguration of an enterprise of this character, it is believed that no mistake has been made. In this city the Madison Square Garden is looked upon as one of the great show places of the metropolis; it contains within its walls the requisite space for the proper display of an almost unlimited amount of product, without which an affair of this kind cannot hope for the stamp of public approval—hence the selection of this great building for the inauguration of the gas industries exposition during the two weeks beginning January 25, 1897.

The greater New York contains a resident population of 3,000,000 people. Within a radius of 50 miles of Madison Square Garden live 4,500,000 people; reliable statistics show that an average of fully 100,000 strangers visit New York every day in the year. Thus it will be seen that the gas exposition will draw from a population of fully 6,000,000. In this connection it may be stated that every effort will be put forth that ingenuity can devise to thoroughly advertise the exposition, and create a desire in the minds of the public to come to the show; and once within its portals the dazzling brilliancy there abounding, coupled with the many attractive and instructive exhibits, will cause the visitor to wish to come again.

It is expected that cooking demonstrations will be a feature of the exposition. The lecture and concert hall, situated conveniently near the great amphitheater, in which the exposition is to take place, affords seating room for 1,200 to 1,400 people. The most experienced and talented ladies obtainable will be selected for this feature of the affair, which must prove one of the show's greatest attractions; not only for the housewives who may be attracted to it, but for gas managers, who will thus have an opportunity to study the advantages these gas cooking demonstrations offer as one of the means at hand for the education of people in the uses of gas.

APPLICATIONS FOR SPACE MUST BE MADE BEFORE OCTOBER 15th, 1896.

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INJUNCTION ISSUED AGAINST INFRINGERS.

On September 23d the United States Circuit Court for the Southern District of New York granted an injunction restraining and enjoining the further infringement of our Welsbach patent. READ IT.

UNITED STATES CIRCUIT COURT,
Southern District of New York.

WELSBACH LIGHT COMPANY,
vs.
A. LIEBES.
} IN EQUITY.

The President of the United States,

TO A. LIEBES, and his servants, agents, attorneys and workmen, GREETING:

WHEREAS, It has been represented to us in our Circuit Court of the United States for the Second Circuit and Southern District of New York, that Letters Patent of the United States No. 438,125, were issued in due form of law on the 7th day of October, 1890, to Carl Auer von Welsbach, assignor of the complainant, then known as "Welsbach Incandescent Gas Light Company of New Jersey," and that the complainant herein is the owner of said Letters Patent, and that you, the said A. Liebes, have infringed the rights secured by the aforesaid Letters Patent, by making, using and selling to others to be used, incandescent devices for gas burners, embodying and containing the invention and improvements described and claimed in said Letters Patent No 438,125.

NOW, THEREFORE, We do strictly command and enjoin you, the said A. Liebes, and your attorneys, agents, servants and workmen, under the penalties which may fall upon you in case of disobedience, that you forthwith and forever desist from directly or indirectly making, or causing to be made, delivering, vending, or causing to be sold, offering for sale, using, or causing to be used in any manner, any incandescent devices for gas burners, like, or similar to those which you have heretofore made, used or sold, containing or embodying the invention and improvements described in said Letters Patent No. 438,125, and claimed in the claim thereof, and from counterfeiting or imitating the said invention or improvements or any part or parts thereof, and from in any manner or way whatsoever, violating or infringing the said Letters Patent No. 438,125 and the claim thereof, and from doing, or causing to be done, any other act or thing whatsoever in infringement of the said Letters Patent No. 438,125.

WITNESS, The Honorable Melville W. Fuller, Chief Justice of the United States, at the City of New York, in the Southern District of New York, this twenty-fourth day of September, A. D., 1896.

(SEAL) JOHN A. SHIELDS, Clerk.

(Endorsed) U. S. Circuit Court, Southern District of New York, in Equity.—Welsbach Light Company vs. A. Liebes. Injunction.

A Copy of a Writ of Injunction this day issued out of my office. JOHN A. SHIELDS, Clerk.

We shall proceed against all infringers; manufacturers, dealers and users being equally liable to injunction and damages. The decree of the court awarding the injunction also awards profits and damages. Do not be misled or deceived by guarantees offered by infringers, as such guarantees will not protect you against suit, injunction and damages. For your own protection see that you get the genuine Welsbach light. All other incandescent gas lights are infringements.

WELSBACH LIGHT COMPANY.

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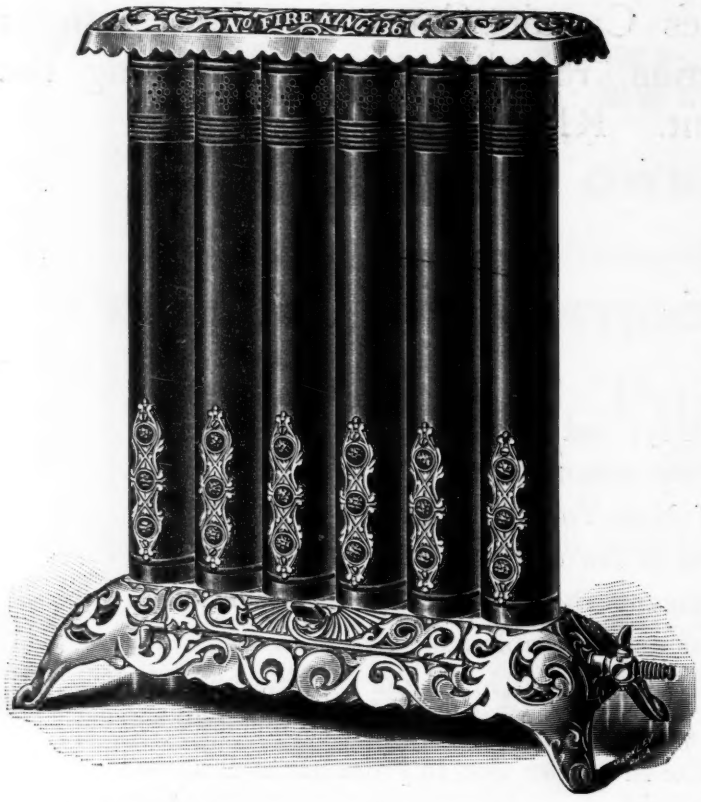

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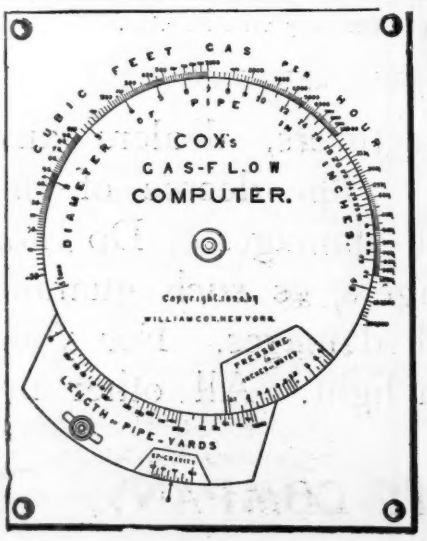

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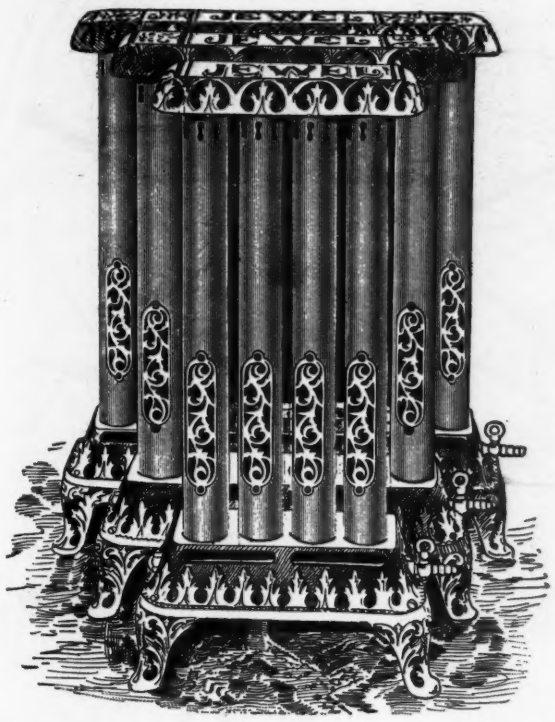

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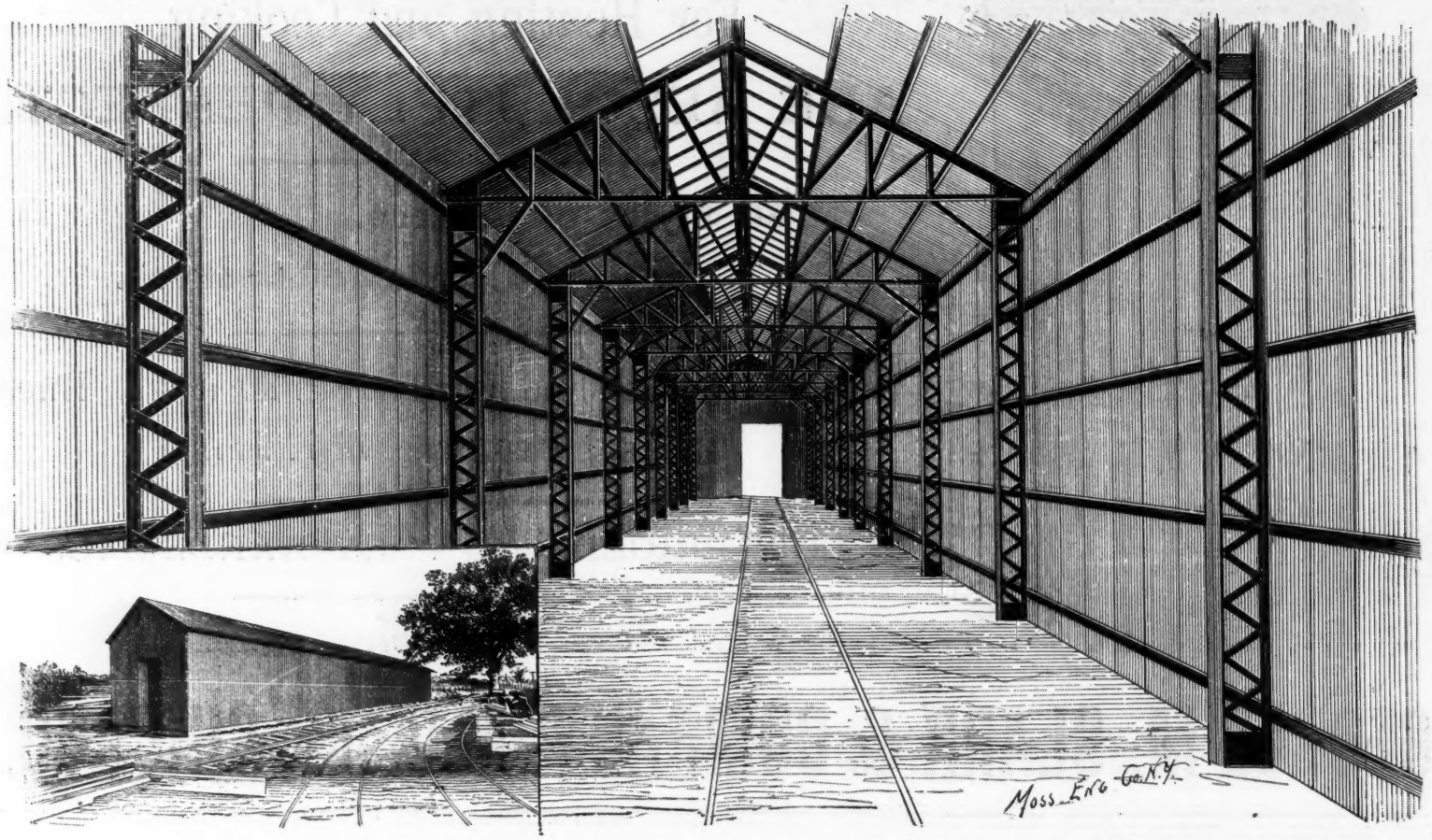

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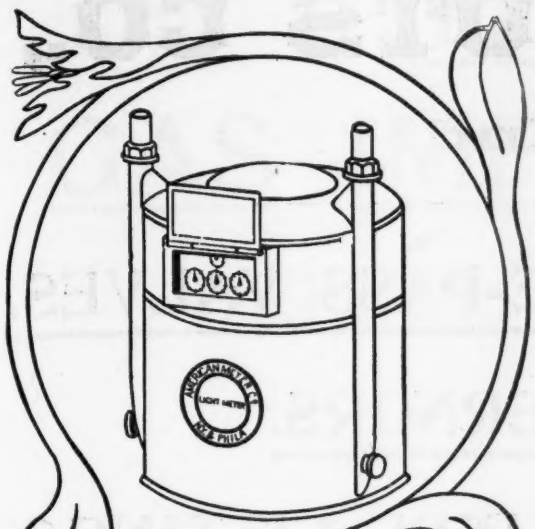

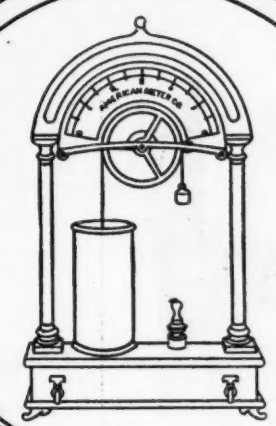

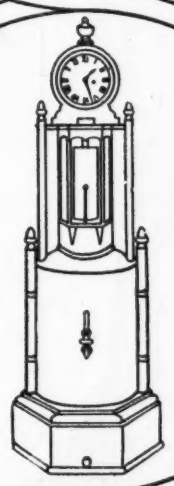

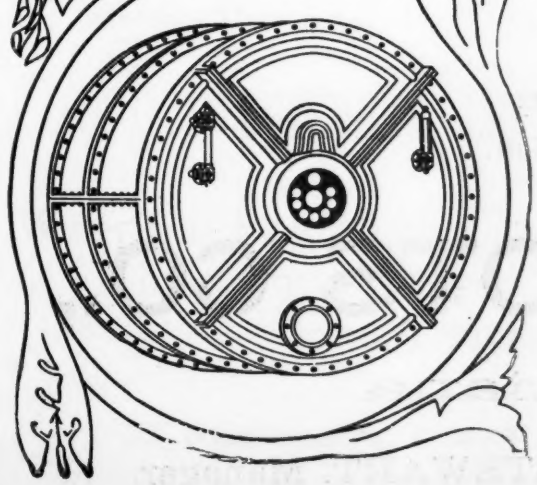

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SAN FRANCISCO.

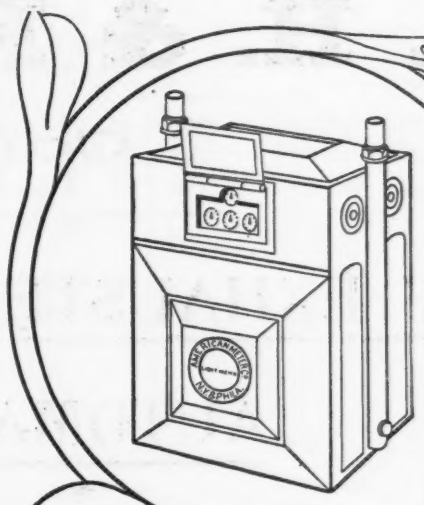
PUBLIC LIGHTING TABLE.

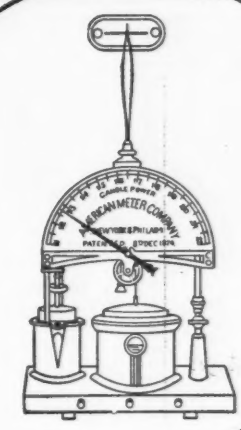
NOVEMBER, 1896.

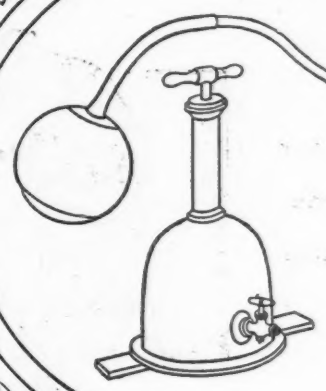
Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Sun.	1	5.20 PM	5.30 AM	4.45	5.35
Mon.	2	5.20	5.30	4.45	5.35
Tue.	3	5.20	5.30	4.45	5.35
Wed.	4	5.20 NM	5.30	4.45	5.35
Thu.	5	5.20	5.30	4.40	5.45
Fri.	6	5.20	5.30	4.40	5.45
Sat.	7	5.20	5.30	4.40	5.45
Sun.	8	5.20	5.40	4.40	5.45
Mon.	9	7.50	5.40	4.40	5.45
Tue.	10	9.00	5.40	4.40	5.45
Wed.	11	10.10 FQ	5.40	4.40	5.45
Thu.	12	11.10	5.40	4.30	6.00
Fri.	13	12.10 AM	5.40	4.30	6.00
Sat.	14	1.10	5.40	4.30	6.00
Sun.	15	2.10	5.50	4.30	6.00
Mon.	16	3.10	5.50	4.30	6.00
Tue.	17	4.10	5.50	4.30	6.00
Wed.	18	No L.	No L.	4.30	6.00
Thu.	19	No L. FM	No L.	4.25	6.00
Fri.	20	No L.	No L.	4.25	6.00
Sat.	21	5.10 PM	6.10 PM	4.25	6.00
Sun.	22	5.10	7.10	4.25	6.00
Mon.	23	5.10	8.10	4.25	6.00
Tue.	24	5.10	9.10	4.25	6.00
Wed.	25	5.10	10.20	4.25	6.00
Thu.	26	5.10	11.30	4.20	6.10
Fri.	27	5.10 LQ	12.40 AM	4.20	6.10
Sat.	28	5.10	1.50	4.20	6.10
Sun.	29	5.00	3.00	4.20	6.10
Mon.	30	5.00	4.20	4.20	6.10

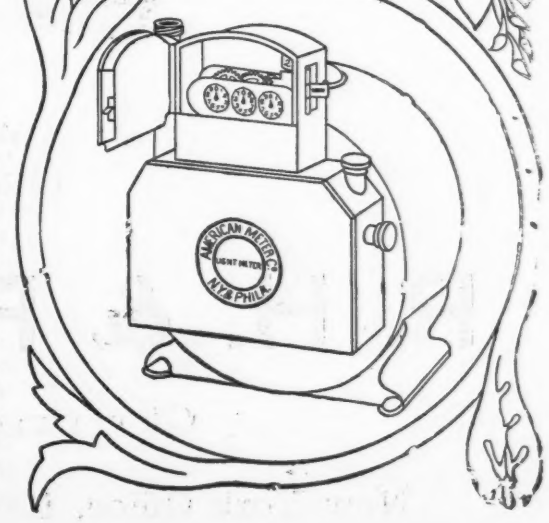
TOTAL HOURS LIGHTING DURING 1896.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	220.40	January	423.20
February	207.00	February	367.40
March	193.00	March	355.35
April	174.10	April	298.50
May	164.00	May	264.50
June	142.10	June	234.25
July	142.10	July	243.45
August	150.50	August	280.25
September	163.00	September	321.15
October	193.10	October	374.30
November	207.00	November	401.40
December	237.30	December	433.45
Total, yr.	2194.40	Total, yr.	4000.00









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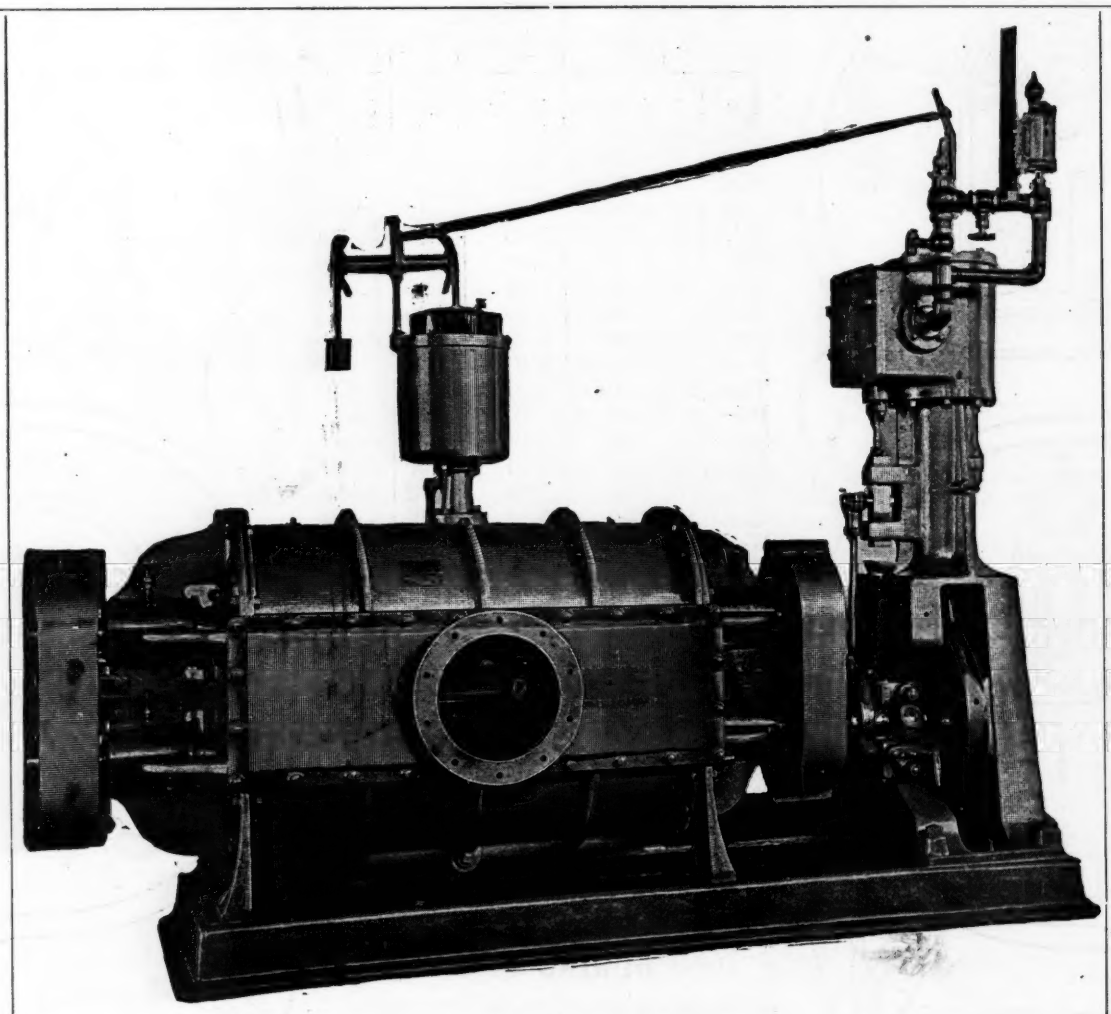

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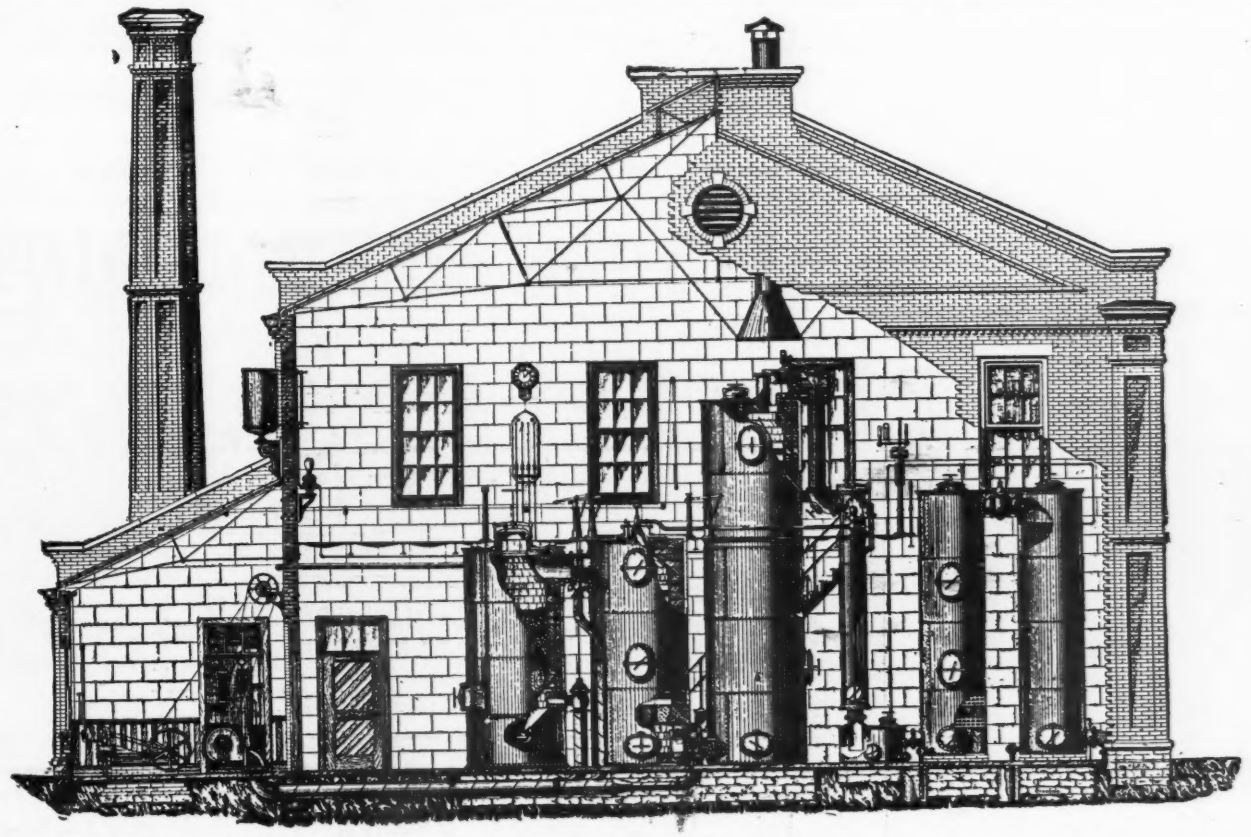

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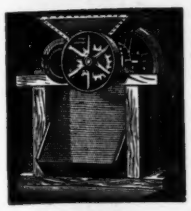

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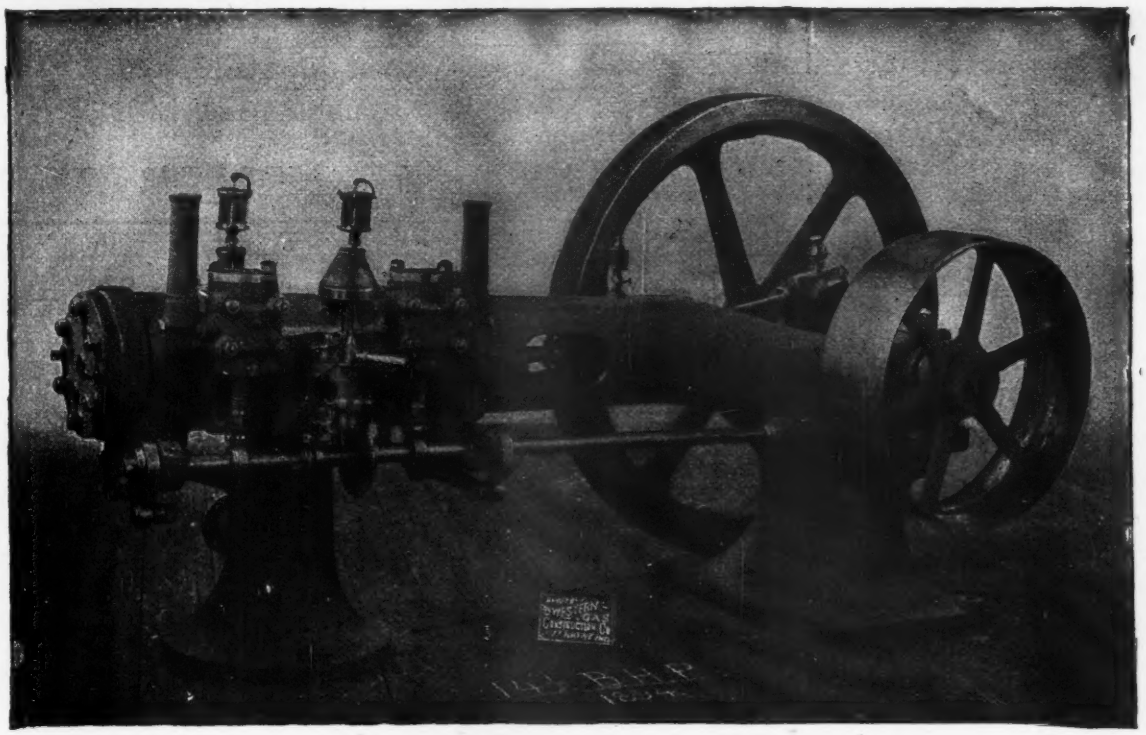

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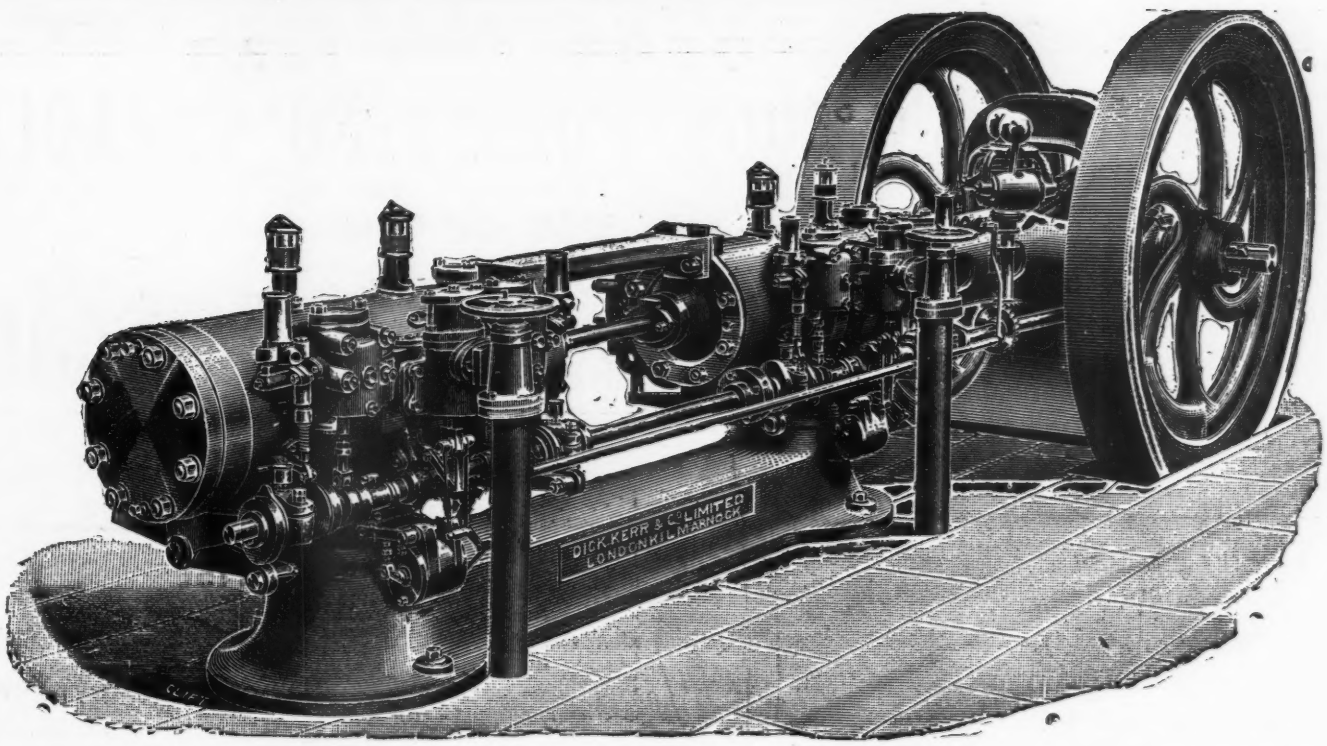

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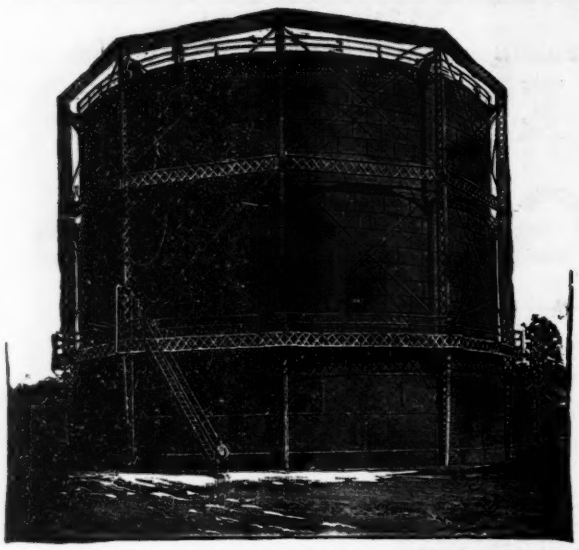

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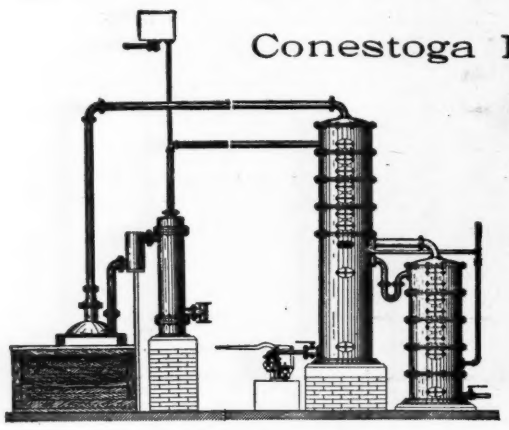

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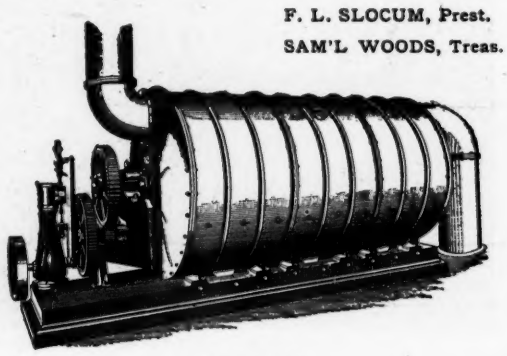

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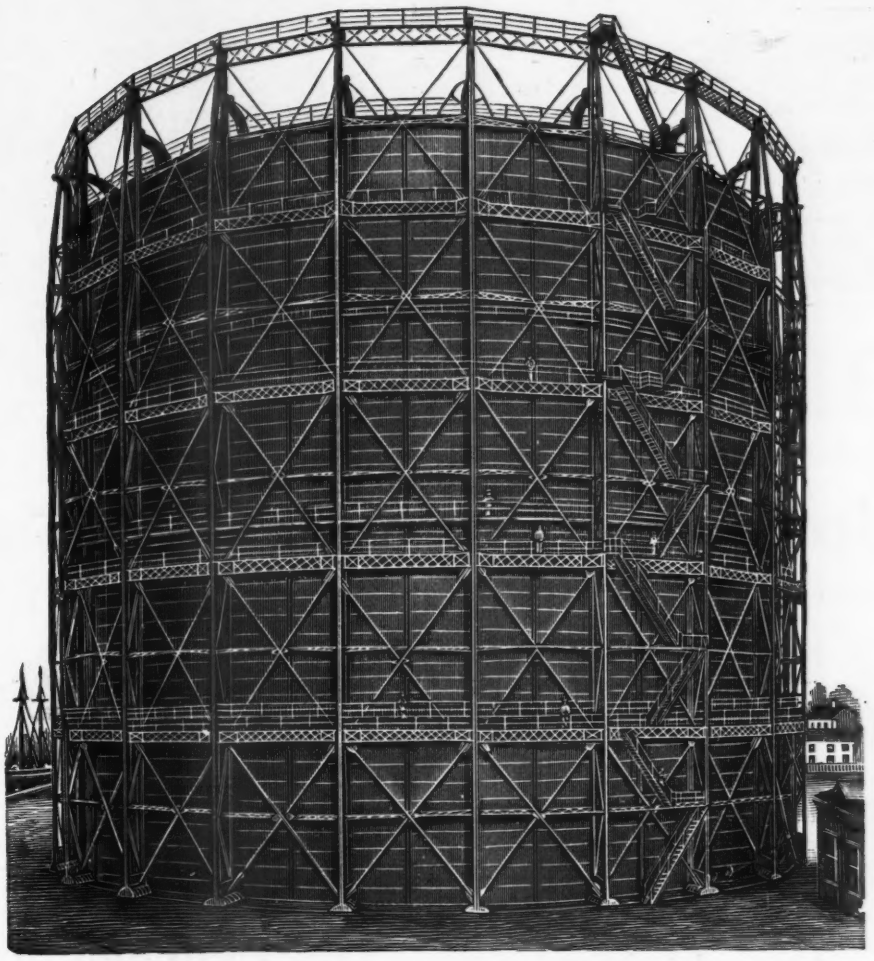

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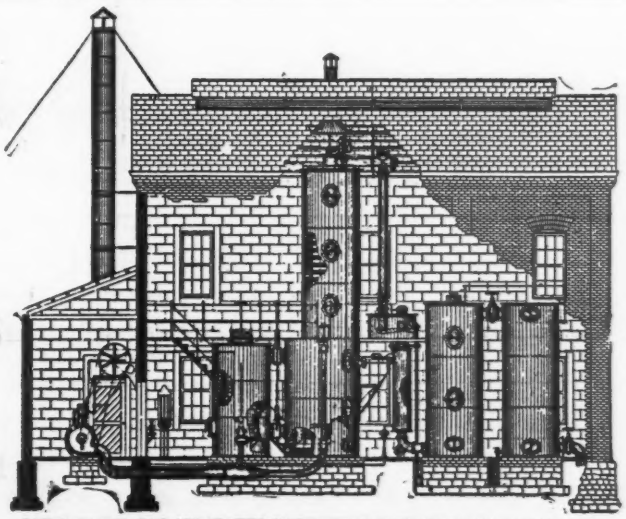

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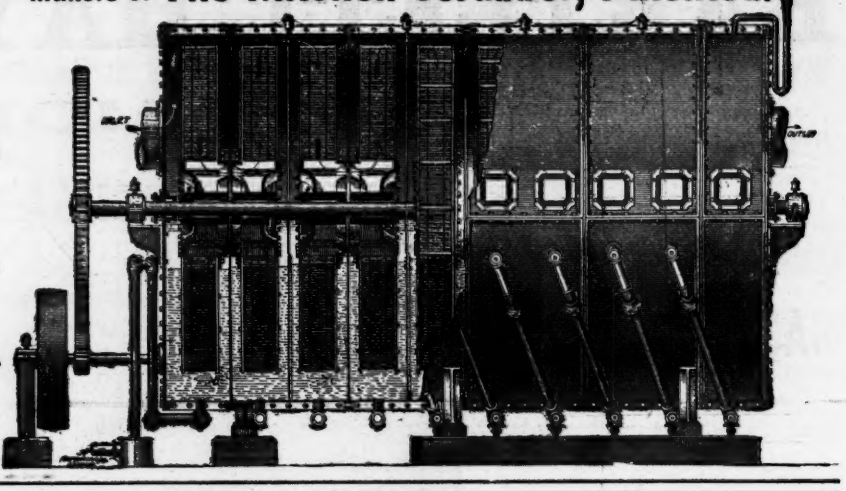

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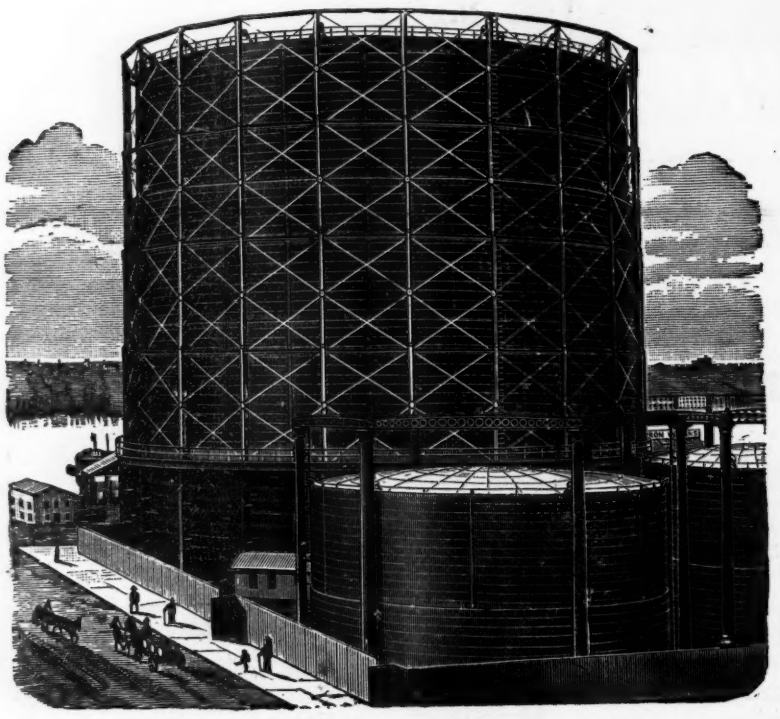

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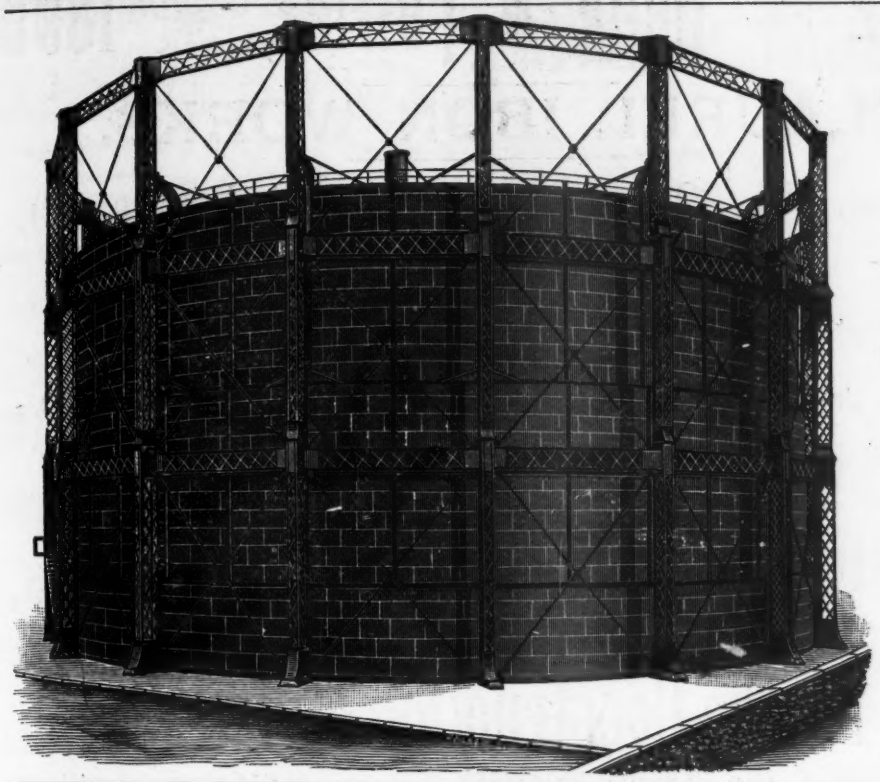

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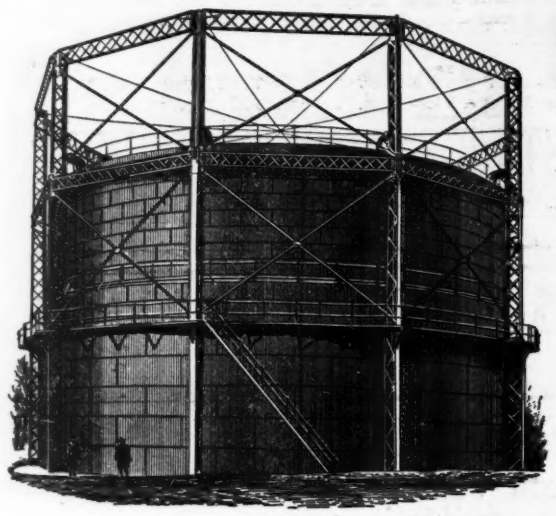

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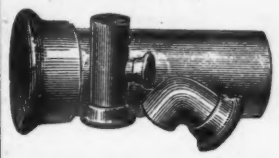

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